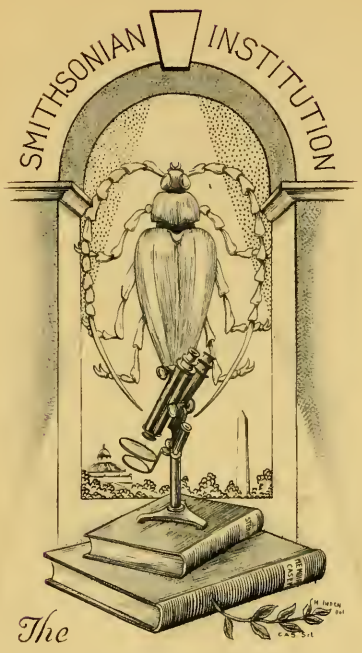

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OF

LONDON

FOR THE YEAR

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1896 Strickland, T. A. Gerald, *Darlingworth House, Cirencester.*
1900 Studd, E. A. C., *Kerremens, B.C.*
1895 Studd, E. F., M.A., B.C.L., *Oxton, Exeter.*
1882 Swanzy, Francis, *Stanley House, Granville-road, Sevenoaks.*
1908 Swierstray, Commr. T., 1st Assistant, *Transvaal Museum, Pretoria*
1884 Swinhoe, Colonel Charles, M.A., F.L.S., F.Z.S., 6, *Gunterstone-road, Kensington,* W.
1894 Swinhoe, Ernest, 6, *Gunterstone-road, Kensington,* W.
1876 Swinton, A. H., c/o Mrs. Callander, *Vineyard, Totnes.*

1908 Talbot, G., 11, *Palace Gardens, Enfield.*
1893 Taylor, Charles B., *Gap, Lancaster County, Penn., U.S.A.*
1903 Taylor, Thomas Harold, M.A., *Yorkshire College, Leeds.*
1901 Thompson, Matthew Lawson, 40, *Gosford-street, Middlesborough.*
1892 Thornley, The Rev. A., M.A., F.L.S., 17, *Mapperley-road, Nottingham.*
1907 Tillyard, R. J., B.A., *The Grammar School, Sydney, New South Wales.*
1897 Tomlin, J. R. le B., M.A., *Stoneley, Alexandra-road, Reading.*
1907 Tonge, Alfred Ernest, *Aincroft, Reigate, Surrey.*
1907 Tragårdh, Dr. Ivar, *The University, Upsala, Sweden.*
1859 † Trimen, Roland, M.A., F.R.S., F.L.S., 133, *Woodstock-road, Oxford.*
1906 Tryhane, George E., *St. Ann's, Trinidad, British West Indies.*
1906 Tulloch, Captain James Bruce Gregorie, *The King's Own Yorkshire Light Infantry*; c/o Messrs. Cox & Co., 16, *Charing Cross,* S.W.
1895 Tunaley, Henry, 13, *Begmead-avenue, Streatham,* S.W.
1898 Turner, A. J., M.D., *Widsham Terrace, Brisbane, Australia.*

1893 Turner, Henry Jerome, 98, *Drakefell-road, St. Catherine's Park, Hatcham*, S.E.
1906 Turner, Roland E., 21, *Emperor's Gate*, S.W.
1894 Turner, Thomas, *Cullompton, Devon.*
1886 Tutt, James W., *Rayleigh Villa, Westcombe Hill*, S.E.
1904 Tylecote, Edward F. S., M.A., *The Lodge, Ringstead, Kings Lynn.*

1893 Urich, Frederick William, C.M.L.S., *Port of Spain, Trinidad, British West Indies.*

1904 † Vaughan, W., *Cocogalla, Madulsima, Ceylon.*
1866 Verrall, George Henry, *Sussex Lodge, Newmarket.*
1897 Vice, William A., M.B., 19, *Belvoir-street, Leicester.*

1895 Wacher, Sidney, F.R.C.S., *Dane John, Canterbury.*
1901 Waddington, John, *Park Holme, Harehill-avenue, Leeds.*
1899 Wade, Albert, 52, *Frenchwood-street, Preston, Lancashire.*
1897 Wainwright, Colbran J., 45, *Handsworth Wood-road, Handsworth, Birmingham.*
1878 Walker, James J., M.A., R.N., F.L.S., Secretary, *Aorangi, Lonsdale-road, Summertown, Oxford.*
1863 † Wallace, Alfred Russel, O.M., D.C.L., Oxon., F.R.S., F.L.S., F.Z.S., *Broadstone, Wimborne, Dorset.*
1866 † Walsingham, The Right Honble. Lord, M.A., LL.D., F.R.S., F.L.S., F.Z.S., High Steward of the University of Cambridge, *Merton Hall, Thetford* ; and 66*a*, *Eaton-square*, S.W.
1906 Walton, Major H. J., M.B., F.R.C.S., Indian Medical Service ; c/o Messrs. H. J. King & Co., 9, *Pall Mall*, S.W.
1886 Warren, Wm., M.A., 33, *Western-road, Tring, Herts.*
1908 Warren, B. C. S., *The Avenue, Amersham.*
1869 Waterhouse, Charles O., President, *Ingleside, Avenue-gardens, Acton*, W. ; and *British Museum* (*Natural History*), *Cromwell-road*, S.W.
1901 Waterhouse, Gustavus A., B.Sc., F.C.S., *Royal Mint, Sydney, New South Wales, Australia.*
1904 Watson, The Rev. W. Beresford, *St. Martin's Vicarage, St. Philip, Barbados, W. Indies.*
1893 Webb, John Cooper, 218, *Upland-road, Dulwich*, S.E.
1908 Wellman, F. Creighton, M.D., *Cuidado de Senhores Silva & Lopes, Benguella, Africa Occidental* (*viâ Lisbon*).
1908 West, F. E., *Peradeniya, Ceylon.*
1876 † Western, E. Young, 36, *Lancaster Gate, Hyde Park*, W.
1886 Wheeler, Francis D., M.A., LL.D., *Paragon House School, Norwich.*
1906 Wheeler, The Rev. George, M.A., *Briarfield, Guildford.*
1907 White, Harold J., 42, *Nevern-sq., Kensington*, S.W.
1906 Wickar, Oswin S., *Crescent Cottage, Cambridge Place, Colombo, Ceylon.*

1903 Wiggins, Clare A., M.R.C.S., *Entebbe, Uganda.*

1896 Wileman, A. E., c/o H.B.M.'s Consul, *Anping, Formosa;* c/o Mrs. Elliott, *Pangbourne, Warwick-road, Clifton Vale, Margate.*

1904 Winterscale, J. C., F.Z.S., *Karangari, Kedah,* c/o Messrs. Patterson, Simons and Co., *Penang, Straits Settlement.*

1894 Wolley-Dod, F. H., *Millarville P. O., Alberta, N.W.T., Canada.*

1900 Wood, H., 9, *Church-road, Ashford, Kent.*

1881 Wood, The Rev. Theodore, *The Vicarage, Lyford-road, Wandsworth Common,* S.W.

1905 Woodbridge, Francis Charles, *The Briars, Gerrard's Cross, S.O., Bucks.*

1888 Yerbury, Colonel John W., late R.A., F.Z.S., *Army and Navy Club, Pall Mall,* S.W.

1892 Youdale, William Henry, F.R.M.S., *Daltonleigh, Cockermouth.*

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ERRATA.

TRANSACTIONS.

Hymenoptera aculeata, collected in Algeria.

Page 177 et seqq.:—

I am indebted to Prof. T. D. A. Cockerell for pointing out that three of the names I have applied to species of *Andrena* in the above paper have been already used by American authors, and require changing. I therefore propose the following new names for them:—

Andrena eatoni for *A. nigra* (p. 195).
Andrena zygophylli for *A. albohirta* (p. 198).
Andrena digamma for *A. delta* (p. 213).
and must apologize to the Society for the errors.—Edward Saunders.

Page 90, line 10 from top, *for* "Maxillary palpi" *read* "Labial palpi."
Page 90, lines 12 and 13 from top, *for* "Labial palpi" *read* "Maxillary palpi."
Page 164, line 11 from bottom, for "*Doryodis*" read "*Doryodes.*"
Page 185, line 8 from bottom, for "*taraxascifolia*" read "*taraxaeifolia.*"
Page 189, line 18 from top, for "*Cleone*" read "*Cleome.*"
Page 210, line 7 from bottom, for "*brachysylis*" read "*brachystylis.*"
Page 269, line 11 from top, for "*pubescens*" read "*pubescens.*"
Page 304, line 12 from bottom, for "*Apiochæta*" read "*Aphiochæta.*"
Page 379, line 13 from top, *for* "Moschs." *read* "Möschl."
Page 381, line 2 from bottom, *for* "Prodn." *read* "Prodr."
Page 384, line 21 from top, *for* "veination" *read* "venation."
Page 384, bottom line, *for* "Diurin." *read* "Diurn."
Page 571, line 7 from top, for "*Aeria*" read "*Aeria.*"

In Explanation of Plate XIX, fig. 2, *for* "Vernet-les-Bains" *read* "Rennes."

TRANSACTIONS

OF THE

ENTOMOLOGICAL SOCIETY

OF

LONDON

FOR THE YEAR 1908.

I. *On the species of* Hesperidæ *from the Indo-Malayan and African Regions, described by* HERR PLÖTZ, *with descriptions of some new species by* COLONEL C. SWINHOE, M.A., F.L.S., etc.

[Read October 2nd, 1907.]

PLATES I—III.

THROUGH the great kindness of Dr. Seitz, of Frankfort, and Director Robert Erhardt, of Munich, I have been so fortunate as to obtain the loan of the six volumes containing the unpublished coloured figures of the *Hesperidæ* described by Plötz. The identification of such obscurely-marked Lepidoptera from descriptions, however carefully worked out, is of itself a more or less hopeless task. Plötz's descriptions are for the most part crude and insufficient, and it has been impossible heretofore to identify most of his published species. Plötz was an indefatigable worker, his twenty-seven volumes of coloured figures of Rhopalocera must have taken him a lifetime. The *Hesperidæ* are the last six, and for the most part his figures are excellent, and a comparison with examples in the collection in the British Museum, the very extensive collection in my own museum, and the published figures of the many authors who have worked at the Family belonging

to the Indo-Malayan region, has resulted in the publication of this paper, which clears up many doubtful points, and will be, I trust, of assistance to future workers.

I have had copies made by the well-known artist, Mr. Horace Knight, of all Plötz's Indo-Malayan species; copies have been made for the British Museum of the Africans, and by Mr. F. Du Cane Godman of the Americans. I have not said anything in this memoir about the Australian examples, because Mr. Oswald Lower, of Broken Hill, New South Wales, is working out the Australian *Hesperidæ*, and I have sent to him copies of all Plötz's figures.

In this paper I have followed the British Museum classification, which is based on Watson's, and I do not know what I should have done without Mr. Heron's kindly assistance, and I have to tender to him my grateful thanks for the free use of all his numerous manuscript notes on the Family.

I have taken notice of only one or two African *Hesperidæ*, Dr. Holland having worked out Plötz's species from that region in certainly the best Hesperid memoir that has ever been published, in the opening pages of P. Z. S., 1896.

The memoir by Elwes and Edwards in Trans. Zool. Soc., xiv (4) (1897), has been of much assistance to me.

I have given generic names, for the sake of convenience, to all the generic sections into which they are divided in the National Collection; whether they are good genera or only sections of genera is to me a matter of small importance. Classification must always be more or less arbitrary; its chief object is facility to workers, and it is much easier in a large museum collection to find an insect for examination when the species are arranged in named sectional groups, than it is to search drawer after drawer in a large genus of many species.

RHOPALOCERA.

Family HESPERIDÆ.

Sub-family *HESPERIINÆ*.

CASYAPA, Kirby, Cat. Lep., p. 576 (1871), type *eorvus*, Felder.

CHÆTOCNEME, Felder, Sitzb. Ak. Wiss. Math. Nat. Cl., vol. xl, p. 460 (1860) (præocc.).

CASYAPA KALLIMA. Pl. I, fig. 1.

Casyapa kallima, Swinhoe, Ann. Mag. N. H. (7 , xx, p. 430, 1907.

Milne Bay, N. Guinea, types in B. M. Allied to *C. callixenus*, Hew., from Dorey.

SATARUPA, Moore, P. Z. S., 1865, p. 780, type *gopala*, Moore.

SATARUPA SAMBARA.

Goniloba sambara, Moore, Cat. Lep. E. I. C., i, p. 246 (1857).
Satarupa sambara, Elwes and Edwards, Trans. Zool. Soc., xiv (4), p. 134 (1897).
Tagiades cosima, Plötz, J. B. Nass. Ver., xxxvii, p. 54 (1884), pl. 1584.

N. India (*Plötz*) (Weymer 493 in plate).

SATARUPA AFFINIS.

Satarupa affinis, Druce, P. Z. S., 1873, p. 360, pl. xxxiii, f. 9.
Tagiades niphates, Weymer, Stett. ent. Zeit., xlvii, pl. i, f. 5 (1886).
Tagiades niphates, Weymer, l. c., xlviii, p. 15 (1887).

Type, Borneo in mus. Godman. Weymer's type came from Padang, Sumatra; I have it also from the same locality.

SATARUPA KIRMANA.

Tagiades kirmana, Plötz, Berl. ent. Zeit., xxix, p. 231 (1885), pl. 1585.
Satarupa affinis, var. *cognata*, Distant, Rhop. Mal., p. 385, pl. xxxv, f. 17 (1886).

Malacca (*Plötz*), type in coll. Erhardt.

Distant's type came from the Malay Peninsula, and he also records it from Perak and Malacca; he says, "this may probably prove to be a distinct species," and I believe it is; it is certainly not *affinis* the type of which came from Borneo. I have it from Sumatra, from which it has also been recorded by de Nicéville, and Pelpers records it from Java.

TAGIADES, Hübner, Verz., p. 108 (1816), type *japetus*, Cram.

Tagiades distans.

Tagiades distans, Moore, Lep. Ceylon, i, p. 175, pl. lxviii, f. 1, 1*a* (1880).
Tagiades athos, Plötz, J. B. Nass. Ver., xxxvii, p. 48 (1884), pl. 1578.

Calcutta (*Plötz*), type in coll. Erhardt.

Distans was sunk to *obscurus* by de Nicéville. I agree with Elwes that the identification of *obscurus* is doubtful; no one seems to have seen the type which is supposed to have come from Java. I have never seen an example of *distans* from any of the Islands; *obscurus* is probably, as Elwes says, a form of *japetus*, Cram., which I have from Amboina, Batchian, and Alu Island, and it has been recorded from Java, Sambawa, Bali, Lombok and the Philippines.

Tagiades utanus. Pl. I, fig. 2.

Tagiades utanus, Plötz, Berl. ent. Zeit., xxix, p. 230 (1885), pl. 1574.

Malacca (*Plötz*), type in coll. Erhardt.

I have an example from Brunei, N. Borneo, which seems to be identical with Plötz's figure; it is nearest *meectana*, Moore, but differs from every species of the genus known to me.

Tagiades neira. Pl. I, figs. 10, 11, 12.

Tagiades neira, Plötz, Berl. ent. Zeit., xxix, p. 230 (1885), pl. 1575.

Aru Islands (*Plötz*), type in coll. Erhardt.

I have both sexes from Aru; it is closely allied to *T. sivoa*, Swinhoe, Ann. and Mag. N. H. (7), xiv, p. 419 (1904), from Humboldt Bay. Plötz has figured two very distinct forms in his plate; these remarks apply to the smaller form with narrow white band on the hind-wings; the other represents a form new to me, allied to *atticus*, Fabr.

Tagiades menanto.

Tagiades menanto, Plötz, Berl. ent. Zeit., xxix, p. 231 (1885), pl. 1577.

Tagiades toba, de Nicév., Journ. Bomb. N. H. Soc., x, p. 19, pl. T, f. 47, ♂ (1895).
Tagiades toba, Elwes and Edwards, Trans. Zool. Soc., xiv (4), p. 144 (1897).

Malacca (*Plötz*), type in coll. Erhardt, Ribbe, 93–94.

This appears to be the Island form of *gana*, Moore, from India, with a narrower white space on the hind-wings and uniformly smaller spots; I have it also from Java and Borneo; de Nicéville's type came from Sumatra.

TAGIADES TITUS. Pl. 1, fig. 3.

Tagiades titus, Plötz, J. B. Nass. Ver., xxxvii, p. 46 (1884), pl. 1086.
Tagiades titus, Semper, Schmett. Philipp., p. 310 (1892).
Tagiades titus, Elwes and Edwards, Trans. Zool. Soc., xiv (4), p. 142, pl. xx, f. 15, ♂ (1897).

Philippines (*Plötz*).

The underside of the hind-wing in the figure is darker and has more blue in it than in any of the examples I have examined, which are in every other respect identical with Plötz's figure; but this colour undoubtedly varies, and I have a female with the underside of the hind-wings pure white. Elwes' figure of *titus* represents a species unknown to me; it represents *latreillei*, Staud., I presume; it has no resemblance to Plötz's figure, therefore I reproduce the latter.

TAGIADES KOWAIA. Pl. I, fig. 4.

Tagiades kowaia, Plötz, Berl. ent. Zeit., xxix, p. 231 (1885), pl. 1576.
Tagiades tindalii, Ribbe, Iris, 1899, p. 254.

N. Guinea (*Plötz*), type in coll. Erhardt, Ribbe, 95.

I have this from Humboldt Bay, N. Guinea, received from Ribbe; there are examples in the British Museum from Kapaur.

TAGIADES MARTINUS.

Tagiades martinus, Plötz, J. B. Nass. Ver., xxxvii, p. 47 (1884), pl. 1090.
Tagiades martinus, Semper, Schmett. Philipp., p. 309, pl. xlix, f. 3, ♂ (1892).

Philippines (*Plötz*).

The underside of the hind-wing is very distinctive; the upperside is well figured by Semper.

TAGIADES MENAKA.

Pterygospidea menaka, Moore, P. Z. S., 1865, p. 778 (nec Plötz).

Tagiades vulturna, Plötz, J. B. Nass. Ver., xxxvii, p. 47 (1884), pl. 1093.

Calcutta (*Plötz*).

These are undoubtedly identical. Plötz misidentified *menaka*; he figures *atticus* as *menaka*.

TAGIADES LOUISA. Pl. I, fig. 5.

Tagiades louisa, Swinhoe, Ann. Mag. N. H. (7), xx, p. 432 (1907).

Rossel Island, types in B. M.

TAGIADES BRIGIDELLA.

Antigonus brigidella, Plötz, Stett. ent. Zeit., xlvii, p. 111 (1886), pl. 1563.

Sarangesa aurimargo, Holland, P. Z. S., 1896, p. 10, pl. iv, f. 8.

Njam (*Plötz*), type in coll. Erhardt.

Dr. Holland seems to have overlooked this species of Plötz, it is not referred to by him; his types came from Gaboon and Sierra Leone; Professor Erhardt has pencilled in the plate "*aurimargo*, Holland," and I think there can be no doubt about it.

SEMALEA, Holland, P. Z. S., 1896, p. 64, type *pulvina*, Plötz.

SEMALEA PULVINA.

Hesperia pulvina, Plötz, Stett. ent. Zeit., xl, p. 353 (1879).

Semalea pulvina, Holland, P. Z. S., 1896, p. 65, pl. ii, f. 14.

Cobalus carbo, Mab., Bull. Soc. Ent. Fr. (6), ix, p. clxix (1889).

Hesperia tenebricosa, Plötz, MS., pl. 264.

Aburi (*Plötz*).

Plötz evidently changed the name of his species after figuring it; there is no figure of *pulvina*, and on the plate representing *tenebricosa* is pencilled "= *pulvina*."

SARANGESA, Moore, Lep. Ceylon, i, p. 176 (1881), type *purendra*, Moore.

Sarangesa bouvieri. Pl. I, fig. 13.

Pterygospidea bouvieri, Mab., Bull. Soc. Zool. Fr., 1877, p. 239.
Sarangesa bouvieri, Holland, P. Z. S., 1896, p. 8.
Antigonus philotimus, Plötz, Stett. ent. Zeit., xl, p. 361 (1879), pl. 1028.

Aburi (*Plötz*).

Plötz's figure shows more spots on the underside of the hind-wings, but this is an uncertain character.

Sarangesa lælius.

Pterygospidea lælius, Mab., Bull. Soc. Zool. Fr., 1877, p. 240.
Ephyriades lælius, Plötz, J. B. Nass. Ver., xxxvii, p. 6 (1884), pl. 1554.
Sarangesa (?) *lælius*, Holland, P. Z. S., 1896, p. 11.
Antigonus synestalmenus, Karsch, Berl. ent. Zeit., xxxviii, p. 263, pl. vi, f. 8 (1893).

Gaboon (*Plötz*), type in coll. Erhardt.
Karsch's type came from Togoland.

Sarangesa albicilia.

Sarangesa albicilia, Moore, Lep. Ceylon, i, p. 176, pl. lxviii, f. 5, 5*a* (1881).
Antigonus sezendis, Plötz, Berl. ent. Zeit., xxix, p. 230 (1885), pl. 1564.

Ceylon (*Plötz*), type in coll. Erhardt.

Sarangesa haplopa. Pl. I, fig. 14.

Sarangesa haplopa, Swinhoe, Ann. Mag. N. H. (7), xx, p. 431 (1907).

E. Ruwenzori, 7000 ft. (*G. Legge*), type in B. M.

COLADENIA, Moore, Lep. Ceylon, i, p. 180 (1881).

Coladenia dan.

Papilio dan, Fab., Mant. Ins., ii, p. 88 (1787).
Coladenia dan, Distant, Rhop. Mal., p. 398, pl. xxxv, f. 27 (1886).

Ephyriades dichroa, Herr.-Schäff., MS.
Ephyriades dichroa, Plötz, J. B. Nass. Ver., xxxvii, p. 5 (1884), pl. 921.

Java (*Plötz*).

CELÆNORHINUS, Hübner, Verz., p. 106 (1816), type *eligius*, Cram.

GEHLOTA, Doherty, Journ. As. Soc. Beng., 1889, p. 131, type *sumitra*, Moore.

NARGA, Mab., C. R. Soc. Ent. Belg., p. lxx (1861), type *chiriquensis*, Mab.

CELÆNORHINUS SPILOTHYRUS.

Eudamus spilothyrus, Felder, Verh. Zool.-bot. Ges. Wien., 1868, p. 283, ♂.
Celænorhinus spilothyrus, Elwes and Edwards, Trans. Zool. Soc., xiv (4), p. 117 (1897).
Plesioneura area, Plötz, Berl. ent. Zeit., xxix, p. 231 (1885), pl. 1582.
Plesioneura fusca, Hmpsn., Journ. As. Soc. Beng., lvii (2), p. 367 (1888).
Celænorhinus fusca, de Nicév., Journ. Bomb. N. H. Soc., iv, p. 186 (1889).

Bengal, Calcutta (*Plötz*), type in coll. Erhardt.

Plötz has figured two examples, presumably male and female. In one the cilia of the hind-wings are alternately black and white, in the other this is not shown; otherwise both figures correspond to examples of *spilothyrus* from Ceylon in my collection. I have examples of *fusca* from the Nilgiri Hills, Lanauli, Mahableshwar, and Travancore; I cannot see how they can be separated from *spilothyrus*. My Javan examples, which stand as *ruficornis*, Mab., seem to be distinct, the three subapical spots between the costa being in almost a straight line, and not curved as in *spilothyrus*.

CELÆNORHINUS CHINENSIS. Pl. I, fig. 6.

Celænorhinus chinensis, Swinhoe, Ann. Mag. N. H. (7), xx, p. 431 (1907).

Omei-Shan, China (*Crowley bequest*), two examples; type in B. M.

Celænorhinus plötzi.

Celænorhinus plötzi, Swinhoe, Ann. Mag. N. H. (7), xx, p. 432 (1907).

Bipindi, Cameroons, one example.
Allied to *C. atratus*, Mab., but quite distinct.

Celænorhinus editus. Pl. I, fig. 7.

Tagiades editus, Plötz, Berl. ent. Zeit., xxix, p. 231 (1885), pl. 1581.
Celænorhinus editus, de Nicév., Journ. Bomb. N. H. Soc., iv, p. 184 (1889).

Aru (*Plötz*).

CHARMION, de Nicév., Journ. As. Soc. Beng., xlii, p. 48 (1894), type *ficulnea*, Hew.

Charmion tola.

Plesioneura tola, Hew., Ann. and Mag. N. H. (5), i, p. 340 (1878).
Charmion tola, Elwes and Edwards, Trans. Zool. Soc., xiv (4), p. 111 (1897).
Plesioneura zawi, Plötz, Berl. ent. Zeit., xxix, p. 225 (1885), pl. 1345.
Plastingia (?) *plesioneuræ*, Staud., Ex. Schmett., p. 299, pl. C, ♀ (1888).

Celebes (*Plötz*), type in coll. Erhardt.
Hewitson's type from Tondano is in the B. M. I have it from Celebes.

Charmion queda. Pl. I, fig. 8.

Plesioneura queda, Plötz, Berl. ent. Zeit., xxix, p. 225 (1885), pl. 1344.
Notocrypta queda, de Nicé., Journ. Bo. N. H. Soc., iv, p. 192 (1889).

Malacca (*Plötz*).
There are two examples in the B. M. from Brunei, N. Borneo; the band in these two examples is much broader than it is in Plötz's figure, but I think there can be no doubt they represent the same species.

LEUCOCHITONEA, Wallgrn., K. Sv. Vet.-Akad. Handl., 1857, Lep. Rhop. Caffr., p. 52, type *levubu*, Wallgrn.

LEUCOCHITONEA LEVUBU.

Leucochitonea levubu, Wallgrn., l. c.
Abantis levubu, Trimen, South Afr. Butt., iii, p. 345, pl. xii, f. 5 (1889).
Abantis levubu, Holland, P. Z. S., 1896, p. 22.
Sapœa lactea, Plötz, Stett. ent. Zeit., xlvi, p. 36 (1885), pl. 857.

Africa (*Plötz*).

ABARATHA, Moore, Lep. Ceylon, i, p. 181 (1881), type *ransonettii*, Felder.

ABARATHA SIAMICA. Pl. I, fig. 9.

Abaratha siamica, Swinhoe, Ann. Mag. N. H. (7), xx, p. 432 (1907).

Shan States, Siam, type in B. M.

HESPERIA, Fabr., Ent. Syst., iii (i), p. 258 (1793), type *malvæ*, Linn.

HESPERIA COLOTES. Pl. I, fig. 15.

Pyrgus colotes, Druce, P. Z. S., 1875, p. 416.
Hesperia colotes, Holland, P. Z. S., 1896, p. 25.
Pyrgus nora, Plötz, Mitth. nat. Ver. Neu-Vorpomm. u. Rüg., 1884, p. 7 (pl. 1541).
Hesperia nora, Holland, l. c.

Loango, Angola (*Plötz*).
Druce's type also came from Angola.

Sub-family *PAMPHILINÆ*.

TELESTO, Boisd., Voy. l'Astrolabe, p. 164 (1832), type *perronii*, Latr.

TELESTO MAYKORA. Pl. I, fig. 16.

Hesperia maykora, Plötz, Berl. ent. Zeit., 1885, p. 225, pl. 1356.
Hesperia maykora, Plötz, Stett. ent. Zeit., xlvii, p. 89 (1886).

Telesto uniformis, Swinhoe, Ann. Mag. N. H. (7), xvi, p. 614 (1905).

Aru (*Plötz*), type in coll. Erhardt.
Uniformis came from Ké Island.

KORUTHAIALOS, Watson, P. Z. S., 1893, p. 76, type *hector*, Watson.

CORYTHÆOLOS, Mab., Wytsman's Gen., xvii, p. 105 (1904).

KORUTHAIALOS FOCULA.

Lychnuchus focula, Plötz, Berl. ent. Zeit., xxvi, p. 263 (1882), pl. 243, ♂, ♀.
Koruthaialos kophene, de Nicév., Journ. Bomb. N. H. Soc., x, p. 21, pl. T, f. 49, ♂, 50, ♀ (1895).

Java (*Plötz*).
De Nicéville's types came from N.E. Sumatra and Java.

KORUTHAIALOS RUBECULA.

Lychnucha rubecula, Plötz, Berl. ent. Zeit., xxvi, p. 264 (1882), pl. 1348.
Lychnuchus lætitia, Plötz, l. c., pl. 1349.
Astictopterus xanites, Distant (nec Butler), Rhop. Mal., p. 402, pl. xxxiv, f. 28 (1886).
Astictopterus xanites, var. *palawites*, Staud., Iris, ii, p. 148 (1889).
Kerana gemmifer, Semper, Schmett. Philipp., p. 318 (1892).
Koruthaialos hector, Watson, P. Z. S., 1893, p. 77.
Koruthaialos hector, Elwes and Edwards, Trans. Zool. Soc., xiv (4), p. 175 (1897).

Borneo (*Plötz*).
I have it from Borneo, Celebes, Perak and Rangoon; it seems to be common in all the Islands, having been recorded also from the Philippines, Pulo Laut, Java, and the Natuna Islands; the orange band on the fore-wings is very variable in shape and extent, there are hardly two specimens alike.

IAMBRIX, Watson, P. Z. S., 1893, p. 76, type *salsala*, Moore.

IAMBRIX SALSALA.

Nisoniades salsala, Moore, P. Z. S., 1865, p. 786.

Iambrix salsala, de Nicév., Journ. As. Soc. Beng., lxviii, p. 233 (1900), ♀.
Apaustus luteipalpis, Plötz, Stett. ent. Zeit., xlvii, p. 106 (1886), pl. 1489.

Ceylon (*Plötz*), type in coll. Erhardt.

Plötz's figure represents the female; this is common in Ceylon and all over India and Burma; I have it from Kandy, Rangoon, Calcutta, Karwar, Nilgiri Hills, Bombay, Poona, Khasia Hills, Sikhim, and Ranikhet.

SUASTUS, Moore, Lep. Ceylon, i, p. 168 (1881), type *gremius*, Fabr.

SUASTUS MINUTA.

Tagiades minuta, Moore, Ann. and Mag. N. H. (4), xx, p. 343 (1877).
Tagiades minuta, Moore, Lep. Ceylon, i, p. 176, pl. lxviii, f. 4, 4*a* (1881).
Apaustus sinhalus, Plötz, Berl. ent. Zeit., xxix, p. 228 (1885), pl. 1468.

Ceylon (*Plötz*).

I have this also from Ceylon, from whence Moore's type came.

ÆROMACHUS, de Nicéville, Journ. Bomb. N. H. Soc., v, p. 214 (1890), type *stigmata*, Moore.

ÆROMACHUS STIGMATA. Pl. I, fig. 17.

Thanaos stigmata, Moore, P. Z. S., 1878, p. 694.
Æromachus stigmata, Elwes and Edwards, Trans. Zool. Soc., xiv (4), p. 189, pl. xix, f. 3, ♂ (1897).
Apaustus discreta, Plötz, Berl. ent. Zeit., xxix, p. 232 (1885), pl. 1477.
Æromachus discreta, Elwes and Edwards, l. c., f. 6, ♂.

India (*Plötz*), type in coll. Erhardt.

Plötz's figure undoubtedly represents *stigmata*, the most common species of the genus in India. Elwes does not say where he got his examples of *discreta* from; his figure certainly has very little resemblance to Plötz's. All Elwes' figures of species of this genus are double their natural size, made purposely, so I imagine, to show more distinctly their markings, which are usually more or less distinct, but he does not say so.

ARNETTA, Watson, P. Z. S., 1893, p. 81, type *atkinsoni*, Moore.

ARNETTA BINGHAMI. Pl. I, fig. 18.

Arnetta binghami, Swinhoe, Ann. Mag. N. H. (7), xx, p. 433 (1907).

Tavoy Valley, Burma (*Bingham*), type in B. M.
Superficially looks like a *Parnara*, but has the venation and antennæ of *Arnetta*.

ZOGRAPHETUS, Watson, P. Z. S., 1893, p. 84, type *sativa*, de Nicé.

ZOGRAPHETUS DURGA. Pl. I, fig. 19.

Apaustus durga, Plötz, Stett. ent. Zeit., xlv, p. 153 (1884), pl. 748.
Isoteinon durga, Semper, Schmett. Philipp., p. 306, pl. xlix, f. 10, ♂ (1892).
Zographetus durga, Elwes and Edwards, Trans. Zool. Soc., xiv (4), p. 201 (1897).

Philippines (*Plötz*), Mus. Berlin, 19836.
I have not seen this species.

SCOBURA, Elwes, Trans. Zool. Soc., xiv (4), p. 204 (1897), type *cephala*, Hew.

ISMA, Watson (nec Distant), P. Z. S., 1893, p. 83.

SCOBURA PHIDITIA.

Hesperia phiditia, Hew., Trans. Ent. Soc. (3), ii, p. 501 (1866).
Suastus phiditia, de Nicév. and Martin, Journ. As. Soc. Beng., 1895, p. 535.
Suastus phiditia, Elwes and Edwards, l. c., p. 180.
Scobura martini, Elwes, l. c., p. 205, pl. xviii, f. 22, ♀.

Sumatra, type in B. M.
It is unfortunate that Elwes did not see Hewitson's type: Elwes' figure of *martini* is so good, there can be no mistake about the identification; his type also came from Sumatra.

ISMA, Distant, Rhop. Mal., p. 386 (1886), type *obscura*, Distant.

LOPHOIDES, Watson, P. Z. S., 1893, p. 84, type *iapis*, de Nicév.

ISMA OBSCURA.

Isma obscura, Distant, l. c., pl. xxxv, f. 19.
Lophoides obscura, Elwes and Edwards, Trans. Zool. Soc., xiv (4), p. 196 (1897).

Singapore (*Distant*).

Watson's type was *iapis*, de Nicéville; as *obscura* and *iapis* belong to the same genus, as Elwes says, then the genus *Lophoides* must fall.

ISMA PROTOCLEA.

Goniloba protoclea, Herr.-Schäff., Prodromus, 1869, p. 195, No. 44.
Goniloba protoclea, Plötz, pl. 554.
Isoteinon iapis, de Nicév., Journ. Bomb. N. H. Soc., v, p. 213, pl. E, f. 9, ♂ (1890).
Lophoides iapis, Watson, P. Z. S., 1893, p. 84.

Herrich-Schäffer described *protoclea* without giving any habitat; Plötz's figure is merely a very carefully-executed coloured drawing of Herrich-Schäffer's type; there can be no doubt that it represents *iapis* of de Nicéville from Burma and the Malay Peninsula.

SANCUS, de Nicév., Journ. Bomb. N. H. Soc., vi, p. 395 (1891), type *subfasciatus*, Moore.

SANCUS PULLIGO.

Tagiades pulligo, Mab., Bull. Soc. Ent. Fr., 1876, p. xxvi.
Sancus pulligo, Semper, Schmett. Philipp., p. 319, pl. xlix, f. 1, ♂ (1892).
Antigonus kethra, Plötz, J. B. Nass. Ver., xxxvii, p. 24 (1884), pl. 1525.
Antigonus forensis, Plötz, l. c., pl. 1523.
Astictopterus ulunda, Staud., Iris, ii, p. 146 (1889).

Borneo, Philippines (*Plötz*).

Plötz's Philippine example is larger than his Bornean example, and is evidently a female; I have a female example of the allied form *subfasciatus*, Moore, from Karwar,

S. India, quite as large, the males being similar in size to those of typical *pulligo*. The Island forms are not identical with *subfasciatus*, Moore, from India; they have all got an obscure discal row of pale spots on the hind-wings below, and none of them that I have examined have the dark fascia of *subfasciatus*. Mabille's type came from Java.

MATAPA, Moore, Lep. Ceylon, i, p. 163 (1881), type *aria*, Moore.

MATAPA PULLA.

Hesperia pulla, Plötz, Stett. ent. Zeit., xliii, p. 315 (1882), pl. 256.

Java (*Plötz*).

I have this from Sourabaya, Java; it is very much paler both above and below and more orange-red than *aria*, Moore, otherwise it is very like it.

TARACTROCERA, Butler, Cat. Lep. Fabr., p. 279 (1869), type *mævius*, Fabr.

TARACTROCERA ARCHIAS.

Pamphila archias, Felder, Sitzb. Ak. Wiss. Math. Nat. Cl., xl, p. 462 (1860).
Taractrocera archias, Elwes and Edwards, Trans. Zool. Soc., xiv (4), p. 185 (1897).
Thymelicus nigrolimbatus, Snellen, Tijd. v. Ent., xix, p. 165, pl. vii, f. 5 (1876).
Telicota nigrolimbata, Distant, Rhop. Mal., p. 384, pl. xxxv, f. 16 (1886).
Thymelicus myconius, Plötz, Stett. ent. Zeit., xlv, p. 289 (1884), pl. 1507.
Hesperia daschaka, Plötz, Berl. ent. Zeit., xxix, p. 227 (1885), pl. 1458.
Padraona daschalia (sic), Mab., Wytsman's Gen., xvii, p. 141 (1904).
Thymelicus talantus, Plötz, l. c., p. 230, pl. 1506.
Thymelicus turica, Plötz, MS., pl. 785.

Batavia, Java, Celebes (*Plötz*); types of *daschaka* and *talantus* in coll. Erhardt.

Recorded also from Malacca, Sarubawa, Bali, and Nias. Elwes says he has compared *nigrolimbatus* with Felder's type of *archias*; Snellen's and Plötz's figures are identical. I have not been able to find any reference for *turica*.

Taractrocera ziclea. Pl. II, fig. 22.

Thymelicus ziclea, Plötz, Stett. ent. Zeit., xlv, p. 289 (1884), pl. 786.

Taractrocera ziclea, Elwes and Edwards, Trans. Zool. Soc., xiv (4), p. 184 (1897).

Taractrocera ziclea, Watson, Journ. Bo. N. H. Soc., x, p. 677, pl. A, f. 8, ♂ (1897).

Philippines (*Plötz*), type in coll. Erhardt.

I have this from the Philippines, and from Thayetmyo, Burma. Watson records it from several parts of Burma. Plötz's figure represents the insect exactly, except that it is rather large, Watson's does not; therefore I refigure it.

Taractrocera aliena. Pl. I, fig. 20.

Hesperia aliena, Plötz, Stett. ent. Zeit., xliv, p. 228 (1883), pl. 700.

Java (*Plötz*).

Apparently closely allied to *T. archias*.

Taractrocera sangira. Pl. I, fig. 21.

Telesto sangira, Plötz, Berl. ent. Zeit., xxix, p. 230 (1885), pl. 1509.

Celebes (*Plötz*), type in coll. Erhardt, Ribb, 84.

KEDESTES, Watson, P. Z. S., 1893, p. 96, type *lepenula*, Wallgrn.

Kedestes macomo.

Cyclopides macomo, Trimen, Trans. Ent. Soc. (3), i, p. 405 (1862).

Kedestes macomo, Holland, P. Z. S., 1896, p. 55.

Hesperia aleta, Plötz, Stett. ent. Zeit., xliv, p. 231 (1883), pl. 703.

Without locality (*Plötz*).

A common South African insect.

Kedestes paola. Pl. I, fig. 23.

Cyclopides paola, Plötz, Stett. ent. Zeit., xlv, pp. 391–2 (1884), pl. 1528.

Cyclopides (?) *paola*, Holland, P. Z. S., 1896, p. 50.

Angola (*Plötz*).

From the figure it might be *K. tucusa*, Trimen, or *protensa*, Butler; it looks very near to either.

KEDESTES BRUNNEOSTRIGA. Pl. I, fig. 24.

Cyclopides brunneostriga, Plötz, Stett. ent. Zeit., xlv, pp. 392–3 (1884), pl. 1529.
Cyclopides (?) *brunneostriga*, Holland, P. Z. S., 1896, p. 51.

Pundo Ndongo (*Plötz*).

This is placed by Plötz next *K. nivcostriga*, Trimen, and certainly belongs to the same genus.

PADRAONA, Moore, Lep. Ceylon, i, p. 170 (1881), type *mæsa*, Moore.

PADRAONA GOLA.

Padraona gola, Moore, P. Z. S., 1877, p. 594, pl. lviii, f. 9, ♂.
Padraona goloides, Moore, Lep. Ceylon, i, p. 171, pl. lxxi, f. 3, 3*a* (1880).
Pamphila akar, Mab., C. R. Soc. Ent. Belg., iii, p. lxxi (1883).
Thymelicus fabriolata, Plötz, Stett. ent. Zeit., xlv, p. 289 (1884), pl. 784.
Apaustus alfurus, Plötz, Berl. ent. Zeit., xxix, p. 229 (1885), ♂, pl. 1496.
Apaustus locus, Plötz, Stett. ent. Zeit., xlvii, p. 107 (1886), ♀, pl. 1497.*

Celebes, Java (*Plötz*).

I think there can be little doubt that these are all one species; I have it from Burma, Perak, Ceylon, Andamans, and the Nilgiri Hills, and it has been recorded by Elwes from Java, Bali, Sumbawa, Pulo Laut, Nias, and the Philippines. Plötz's *locus* has no locality, but it is undoubtedly a female of this species; the sub-basal spots on the hind-wings are unusual, but I have a female from Burma and another from the Andamans similarly marked.

PADRAONA PSEUDOMESA.

Padraona pseudomesa, Moore, Lep. Ceylon, i, p. 170 (1881).
Hesperia zatilla, Plötz, Stett. ent. Zeit., xlvii, p. 103 (1886), pl. 1462.

Without locality (*Plötz*).

Probably from India or Ceylon.

* *socus* in plate.

Padraona tropica. Pl. II, fig. 7.

Hesperia tropica, Plötz, Stett. ent. Zeit., xliv, p. 230 (1883), pl. 698.

Mexico (*Plötz*), on the plate Java.

There can be no doubt Mexico was inserted in error; there is an example in the B. M. from Java identical with Plötz's figure; it is very near *dara*, Kollar, from India.

Padraona euria.

Hesperia euria, Plötz, Stett. ent. Zeit., xliv, p. 229 (1883), pl. 1486.
Pamphila orphitus, Mab., Compt. Rend. Ent. Belg., xxvii, p. lxxiv (1883).
Telicota orphitus, Elwes and Edwards, Trans. Zool. Soc., xiv (4), p. 256 (1897).
Padraona pavor, de Nicé., Journ. As. Soc. Beng., lxiii, p. 53, pl. iv, f. 8 (1894).

Sumatra (*Plötz*).

I have this from Sumatra. De Nicéville's type also came from Sumatra.

Padraona sunias. Pl. I, fig. 22.

Pamphila sunias, Felder, Sitzb. Ak. Wiss. Math. Nat. Cl., xl, p. 462, sep. p. 15 (1860).
Telicota dara, Elwes and Edwards (pars), Trans. Zool. Soc., xiv (4), p. 254 (1897).
Hesperia ahrendti, Plötz, Stett. ent. Zeit., xliv, p. 230 (1883), pl. 695.

Amboina (*Plötz*).

Felder's type came from Amboina; this figure agrees with Felder's description; according to Elwes, who took some trouble in trying to find the type, it has got misplaced in the Felderian collection at Tring. I do not think there can be any doubt about this identification.

Padraona zeno.

Pamphila zeno, Trimen, Trans. Ent. Soc. (3), ii, p. 179 (1864).
Padraona zeno, Holland, P. Z. S., 1896, p. 59.
Pamphila splendens, Mab., Pet. Nouv. Ent., ii, p. 114 (1877).

Hesperia coanza, Plötz, Stett. ent. Zeit., xliv, p. 232 (1883), pl. 1466.
Padraona watsoni, Butler, P. Z. S., 1893, p. 671.

Angola (*Plötz*).
A common African Hesperid, also recorded from South and Central Africa.

PADRAONA WAMBA. Pl. II, fig. 8.

Hesperia wamba, Plötz, Stett. ent. Zeit., xlvii, p. 103 (1886), pl. 1463.

Aru (*Plötz*), type in coll. Erhardt.
There is an example from Aru and another from Ké in the B. M.; this species is called *wama* in Plötz's plate and in his index.

PADRAONA DARA.

Hesperia dara, Kollar, Hügel's Kaschmir, iv, p. 455 (1848).
Padraona dara, Elwes and Edwards (pars), Trans. Zool. Soc., xiv (4), p. 254 (1897).
Pamphila zebra, Mab., Pet. Nouv. Ent., p. 167 (1877).
Hesperia nala, Plötz, Stett. ent. Zeit., xliv, p. 231 (1883), pl. 1464.

India (*Plötz*), type in coll. Erhardt.
On the plate Erhardt has written "= *zebra,* Mab." Mabille himself sank his *zebra* to *dara* with a query in Wytsman's Gen. Ins. Hesp., p. 141 (1904).

TELICOTA, Moore, Lep. Ceylon, i, p. 169 (1881), type *augias,* Linn.

TELICOTA ARUANA. Pl. II, fig. 9.

Hesperia aruana, Plötz, Stett. ent. Zeit., xlvii, p. 103 (1886), pl. 1460.
Pamphila autoleon, Miskin, Proc. Roy. Soc. Queensland, 1889, p. 147.

Aru (*Plötz*), type in coll. Erhardt.
The figure corresponds with verified examples of *autoleon* in coll. Hewitson.

Telicota ternatensis. Pl. II, fig. 10.

Telicota ternatensis, Swinhoe, Ann. Mag. N. H. (7), xx, p. 433 (1907).

Ternate (*Wallace*), type in B. M.
Morotai (*Bernstein*).

This species is not unlike *palmarum*, Moore, but that insect belongs to Mabille's genus *Corone*, the species of which, though resembling *Telicota*, have no sex mark.

CORONE, Mab., Pet. Nouv. Ent., p. 205 (1878), type *ismenoides*, Mab.

Corone chrysozona. Pl. II, fig. 11.

Hesperia chrysozona, Plötz, Stett. ent. Zeit., xliv, p. 237 (1883), pl. 709.

Padraona chrysozona, Semper, Schm. Philipp., p. 301, pl. xlix, f. 13, ♂, 14, ♀ (1892).

Telicota palmarum, (part) Elwes and Edwards, Trans. Zool. Soc., xiv (4), p. 262 (1897).

Philippines (*Plötz*).

This certainly is not *palmarum*, Moore, which I have from Sikhim and the Khasia Hills; Plötz's figure is excellent, Semper's is very bad, I therefore refigure it.

Corone dobboë. Pl. II, fig. 12.

Hesperia dobboë, Plötz, Berl. ent. Zeit., xxix, p. 227 (1885), pl. 1459.

Aru (*Plötz*), type in coll. Erhardt.

There is an example from Aru Island and two from Ké in the B. M.

Corone kobros.

Plastingia kobros, Plötz, Berl. ent. Zeit., xxix, p. 228 (1885), pl. 1467.

Padraona procles, de Nicé., Journ. Bo. N. H. Soc., vii (3), p. 353, pl. J, f. 7, ♂, 8, ♀ (1893).

Aru (*Plötz*), type in coll. Erhardt.

Plötz's figure only faintly indicates the orange band of the hind-wings running up the interior nervules towards the base; but I also have examples of *procles* from Aru Island exactly corresponding with de Nicéville's figure; his types came from the adjacent Island of Ké, from whence there is a nice series in the B. M.

OCYBADISTES, Heron, Ann. and Mag. N. H. (6), xiv, p. 105 (1894), type *walkeri*, Heron.

Ocybadistes marnas. Pl. II, fig. 13.

Pamphila marnas, Felder, Sitzb. Ak. Wiss. Math. Nat. Cl., xl, p. 462 (1860).

Telicota marnas, Elwes and Edwards, Trans. Zool. Soc., xiv (4), p. 256 (1897).

Apaustus dschilus, Plötz, Berl. ent. Zeit., xxix, p. 229 (1885), pl. 1494.

N. Guinea (*Plötz*), type in coll. Erhardt.

The band on the hind-wing in Plötz's figure is rather narrower than usual, otherwise it is similar to examples in my own collection from N. Guinea, which correspond with Elwes' description given from an example in the Felder collection labelled in contemporary handwriting "Amboina Doleschall." There are examples of *marnas* in the B. M. from Amboina, Morty, N. Guinea, and Queensland.

Ocybadistes flavoguttata. Pl. II, fig. 14.

Hesperia flavoguttata, Plötz, Stett. ent. Zeit., xliv, p. 231 (1883), pl. 696.

Manilla (*Plötz*).

I think this locality must be wrong; there are several examples from Australia in the B. M. and in my own collection which correspond very well with Plötz's figure; it is not noticed by either Semper or Elwes.

Ocybadistes tanus. Pl. II, fig. 15.

Apaustus tanus, Plötz, Berl. ent. Zeit., xxix, p. 228 (1885), pl. 1493.

N. Guinea (*Plötz*), type in coll. Erhardt.

There are examples in the B. M. from N. Guinea.

BAORIS, Moore, Lep. Ceylon, i, p. 165 (1881).

Type, *B.* (*Hesperia*) *oceia*, Hewits.

Baoris beraka. Pl. III, fig. 1.

Hesperia beraka, Plötz, Berl. ent. Zeit., xxix, p. 227 (1885), pl. 1427.

Celebes (*Plötz*), type in coll. Erhardt.

This looks like a very large female of *Baoris oceia*, Hew.

? Baoris sakara. Pl. II, fig. 16.

Hesperia sakara, Plötz, Stett. ent. Zeit., xlvii, p. 90 (1886), pl. 1358.

N. Guinea (*Plötz*), type in coll. Erhardt.
Unknown to me.

CALTORIS, Swinhoe, Trans. Ent. Soc., 1893, p. 393, type *kumara*, Moore.

Polytremis, Mab., Wytsman's Genera, xvii, p. 136 (1904).

Caltoris nirwana. Pl. II, fig. 20.

Hesperia nirwana, Plötz, Stett. ent. Zeit., xliii, p. 436 (1882), pl. 387.

Java (*Plötz*).
If the lowest white spot on the fore-wings was placed more inwards, in a line with the discal row, this figure would exactly resemble *Caltoris conjuncta*, Herr.-Schäff., a common Javan insect; I have Javan examples quite as large and otherwise identical.

Caltoris assamensis.

Parnara assamensis, Wood—Mason, and de Nicév., Journ. As. Soc. Beng., 1882, p. 65.
Hesperia alice, Plötz, Stett. ent. Zeit., xliv, p. 45 (1883), pl. 543.

Mergui, Philippines (*Plötz*).
Recorded from Sikhim and Assam; I have examples from Cherra Punji, in Assam, exactly like Plötz's figure; it seems as if Plötz thought Mergui was in the Philippines.

Caltoris laraca. Pl. II, fig. 21.

Caltoris laraca, Swinhoe, Ann. Mag. N. H. (7), xx, p. 434, (1907).

Woodlark Island (*Meek*), type in B. M.

Caltoris jolanda. Pl. III, fig. 3.

Hesperia jolanda, Plötz, Stett. ent. Zeit., xlvii, p. 95 (1886), pl. 1404.
Parnara tulsi, Elwes and Edwards (pars), Trans. Zool. Soc., xiv (4), p. 284 (1897).

Java (*Plötz*).
Elwes and Edwards sink this species to *tulsi*, fide

Mabille, but Mabille must have been mistaken in his identification of *tulsi*; I have two pairs of that species identified by de Nicéville. Plötz's figures do not at all represent them; his male is uncommonly like de Nicéville's figure of *Zampa zenon*, Journ. Bomb. N. H. Soc., ix (4), p. 391, pl. Q, f. 58 (1895); but his female (and they are evidently a pair) resembles nothing with which I am acquainted; without examining the type specimen it is impossible to say to what genus it belongs.

CALTORIS COLACA.

Hesperia colaca, Moore, P. Z. S., 1877, p. 594, pl. lviii, f. 7.

Parnara cingala, Moore, Lep. Ceylon, i, p. 167, pl. lxx, f. 3*a*, 3*b* (1881).

Hesperia urcjus, Plötz, Berl. ent. Zeit., xxix, p. 226 (1885), pl. 1415.

Hesperia sarona, Plötz, l. c., xlvii, p. 90 (1886), pl. 1429.

Aru, Java, India (*Plötz*), both types in coll. Erhardt.

All over India and Ceylon; recorded also from Bali and from Nias. The spots on the fore-wings above and below are smaller than usual, but I have one from Bombay with these spots quite as small. At the end of the cell there are generally two spots, sometimes only one, and sometimes both are obsolescent; in the figures in Plate 1415 there is only one, in 1429 both are absent; I have Indian examples like both.

CALTORIS BEVANI.

Hesperia bevani, Moore, P. Z. S., 1878, p. 688.

Hesperia vaika, Plötz, Stett. ent. Zeit., xlvii, p. 96 (1886), pl. 1414, ♂.

Parnara thyone, Leech, Butt. China, &c., p. 610, pl. xlii, f. 4, ♂ (1894).

India (*Plötz*).

Common all over the East; I have it from many Indian localities from the north to the south, from the Philippines, N. Guinea, and Borneo.

CHAPRA, Moore, Lep. Ceylon, i, p. 169 (1881), type *mathias*, Fabr.

CHAPRA AGNA.

Hesperia agna, Moore, P. Z. S., 1865, p. 791.

Hesperia chaya, Moore, l. c.
Baoris chaya, Distant, Rhop. Mal., p. 384, pl. xxxiv, f. 9 (1886).
Hesperia ella, Plötz, Stett. ent. Zeit., xliv, p. 45 (1883), pl. 549.
Hesperia balarama, Plötz, l. c., p. 46, pl. 552.

Java, Philippines (*Plötz*), type *ella* in coll. Erhardt.

The type of *balarama* is from the Philippines.

The latter is much the larger, but the species varies much in size, and is common in all the Islands as well as all over India and China; I have it in my own collection from the Philippines, Borneo, Japan, and many parts of India; it is merely a form of the still more common *Chapra mathias*, Fabr., with one extra subapical white dot.

PARNARA, Moore, Lep. Ceylon, i, p. 166 (1881), type *guttatus*, Brem.

Parnara guttatus.

Endamus guttatus, Bremer and Grey, Schm. N. China's, p. 10, pl. iii, f. 2 (1853).
Hesperia fortunei, Felder, Verh. Zool.-bot. Ges. Wien., xii, p. 489 (1862).
Pamphila mangala, Moore, P. Z. S., 1865, p. 792.
Hesperia sifa, Plötz, Stett. ent. Zeit., xlvii, p. 96 (1886), pl. 1418.
Hesperia kolantus, Plötz, Berl. ent. Zeit., xxix, p. 227 (1885), pl. 1421.
Hesperia nondoa, Plötz, l. c., p. 97, pl. 1422.

Java, India, Manilla (*Plötz*).

The spots in this species vary very much in size; at the end of cell of fore-wings there are generally two spots, sometimes only the lower one. Watson in his monograph of the Family in P. Z. S., 1893, keeps *guttatus* and *bada* as distinct forms.

Parnara bada.

Hesperia bada, Moore, P. Z. S., 1878, p. 688.
Parnara bada, Moore, Lep. Ceylon, i, p. 167, pl. lxx, f. 2, 2*a* (1881).
Hesperia intermedia, Herr.-Schäff., MS., Plötz, Stett. ent. Zeit. xliv, p. 44 (1882).

Hesperia haga, Plötz, l. c., xlvii, p. 96 (1886), pl. 1416.

Java and Manilla (*Plötz*).

The white spots on *intermedia* from Java are more pronounced than those on the Manilla insect, but the size of the spots on the fore-wings and the number of spots of the hind-wings are very variable; I have an example from the Philippines with the spots quite as prominent and complete as those in the Javan example figured by Plötz; *bada* is only a small form of *Parnara guttata*, Brem., from China and Japan, of which I have many examples, but it seems to be a constant form without any spots at the end of the cell of fore-wings, and is common in India and the Islands.

PARNARA WAMBO. Pl. II, fig. 17.

Hesperia wambo, Plötz, Stett. ent. Zeit., xlvii, p. 97 (1886), pl. 1420.
Chapra wambo, Holland, P. Z. S., 1896, p. 62.

Africa (*Plötz*).

This certainly is a *Parnara* and not a *Chapra*; neither the figure nor the description show any stigma; it very closely resembles *guttatus*, Brem.

PARNARA DÄNDELI. Pl. II, fig. 18.

Hesperia dändeli, Plötz, Berl. ent. Zeit., xxix, p. 226 (1885), pl. 1417.

Batavia (*Plötz*).

This insect is unknown to me.

PARNARA POUTIERI. Pl. II, fig. 19.

Hesperia poutieri, Boisd., Faun. ent. Madag., p. 66 (1833).
Parnara poutieri, Holland, P. Z. S., 1896, p. 63.
Hesperia ibara, Plötz, Stett. ent. Zeit., xliv, p. 38 (1883), pl. 1398.
Chapra mathias, Holland (part), l. c., p. 61.

Madagascar (*Plötz*).

Plötz's figure looks like *poutieri*, it comes from the same locality and has no stigma, and therefore I think Dr. Holland was wrong to sink it to *mathias*; he does not say that he saw Plötz's type.

NOTOCRYPTA, de Nicé., Journ. Bo. N. H. Soc., iv, p. 188 (1889), type *curvifascia*, Felder.

PLESIONEURA, Felder, Wien. ent. Mon., vi, p. 29 (1862) (præocc.), type *curvifascia*, Felder.

NOTOCRYPTA FEISTHAMELII.

Thymele feisthamelii, Boisd., Voy. l'Astrolabe, Ent., p. 159, Lep., pl. iii, f. 6 (1832).
Notocrypta feisthamelii, Elwes and Edwards, Trans. Zool. Soc., xiv (4), p. 239 (1897).
Plesioneura varians, Maassen, pict. 1, pl. xxxix, f. 11.
Plesioneura varians, Plötz, Berl. ent. Zeit., xxvi, p. 262 (1882), pl. 237.
Notocrypta varians, de Nicév., Journ. Bomb. N. H. Soc., iv, p. 192 (1889).

S. Asia (*Plötz*).

This is nothing but *feisthamelii*, and most certainly came from India; I have many examples identically the same from various parts which exactly correspond with Island examples.

NOTOCRYPTA ALYSOS.

Plesioneura alysos, Moore, P. Z. S., 1865, p. 789.
Plesioneura chimæra, Keferstein, MS., i, p. 1 (1882).
Plesioneura chimæra, Plötz, Berl. ent. Zeit., xxvi, p. 262 (1882), pl. 238.
Notocrypta chimæra, de Nicév., Journ. Bomb. N. H. Soc., iv, p. 192 (1889).

India (*Plötz*).

A beautiful figure of typical *alysos*, which is very closely allied to, if not identical with, *feisthamelii*.

NOTOCRYPTA WAIGENSIS. Pl. III, fig. 10.

Plesioneura waigensis, Plötz, Berl. ent. Zeit., xxvi, p. 263 (1882), pl. 240.
Plesioneura waigensis, Ribbe, Iris, i, p. 86 (1886).
Notocrypta waigensis, de Nicév., Journ. Bomb. N. H. Soc., iv, p. 192 (1889).

Waigiou (*Plötz*).

One of the many forms of *feisthamelii*, Boisd. I agree with Elwes and Edwards (p. 239) that it is not possible to

distinguish between these forms, which have many names. I have examples corresponding with *waigensis* from N. Guinea, Java, Ké Island, Cairns in Australia, and many parts of India.

NOTOCRYPTA INSULATA. Pl. III, fig. 9.

Plesioneura insulata, Butler, Ann. and Mag. N. H. (5), x, p. 154 (1882).
Plesioneura insulata, Butler, l. c., xi, p. 424 (1883).
Notocrypta insulata, de Nicév., Journ. Bomb. N. H. Soc., iv, p. 190 (1889).
Plesioneura wokana, Plötz, Berl. ent. Zeit., xxix, p. 225 (1885), pl. 346.

Aru (*Plötz*), type in coll. Erhardt.

Butler records it from N. Britain and Aru, and I have two from Ké Island; also one from the Duke of York Island; the markings above and below are similar.

NOTOCRYPTA ALUENSIS. Pl. III, fig. 11.

Notocrypta aluensis, Swinhoe, Ann. Mag. N. H. (7), xx, p. 434 (1907).

Alu Island, types in B. M.

Somewhat resembling *N. wokana*, Plötz, from Aru and Ké Islands.

? NOTOCRYPTA LEUCOGRAPHA. Pl. II, fig. 1.

Plesioneura leucographa, Plötz, Berl. ent. Zeit., xxvi, p. 262 (1882), pl. 235.
Notocrypta leucographa, de Nicév., Journ. Bomb. N. H. Soc., iv, p. 192 (1889).
Charmion ficulnea, (part) Elwes and Edwards, Trans. Zool. Soc., xiv (4), p. 111 (1897).

India.

I do not know this species. The figure certainly does not represent *Charmion ficulnea*, Hew. = *signata*, Druce; the white band is at a different angle and ends in a point hindwards, the antennæ are those of a *Notocrypta*; in *ficulnea* the band terminates squarely on vein 2 in every example I have examined, and the antennæ are very different.

ASTICTOPTERUS, Felder, Wien. ent. Mon., iv, p. 401 (1860), type *jama*, Felder.

Asticopterus jama. Pl. II, fig. 2.

Astictopterus jama, Felder, Wien. ent. Mon., iv, p. 401 (1860).
Astictopterus jama, Elwes and Edwards, Trans. Zool. Soc., xiv (4), p. 172 (1897) (note).
Isoteinon melania, Plötz, Berl. ent. Zeit., xxix, p. 230 (1885), pl. 1522.
Astictopterus melania, Plötz, Stett. ent. Zeit., xlvii, p. 110 (1886).

Malacca (*Plötz*).

Elwes points out that the insect which stands in the Felder collection as *jama* is not that insect, and does not correspond with Felder's description; it is *Koruthaialos zanites*, Watson. Felder's description compares his *jama* with *pygmæa*, Fabr., which certainly is allied to *melania*; there are examples from Malacca, Sclangor, and Sumatra in the B. M., and I have it from Perak and Karwar in Southern India; there are no markings above or below, the shade of colour being somewhat paler than it is above, and with a slight ochreous-pinkish tinge.

PARDALEODES, Butler, Ent. Mo. Mag., vii, p. 96 (1870), type *edipus*, Cram.

Pardaleodes incerta.

Pamphila incerta, Snellen, Tijd. voor Ent. 1872, p. 29, pl. 10, f. 10, 11, 12.
Pardaleodes incerta, Holland (part), P. Z. S., 1896, p. 75.
Hesperia murcia, Plötz, Stett. ent. Zeit., xliv, p. 229 (1883), pl. 749.

W. Africa (*Plötz*).

PLASTINGIA, Butler, Ent. Mo. Mag., vii, p. 95 (1870), type *flavescens*, Felder.

Plastingia corissa.

Hesperia corissa, Hew., Ann. and Mag. N. H. (4), xviii, p. 455 (1876).
Plastingia corissa, Elwes and Edwards, Trans. Zool. Soc., xiv (4), p. 229 (1897).

Plastingia drancus, Plötz, Stett. ent. Zeit., xlv, p. 149 (1884), pl. 726.
Isoteinon indrasana, Elwes and de Nicév., Journ. As. Soc. Beng., 1886, p. 441, pl. xx, f. 5, ♀ (1886).

No locality (*Plötz*).

Plötz's figure is identical with Hewitson's type, with which I have compared it; in the plate is written in pencil "= *corissa*, Hew."

LOTONGUS, Distant, Rhop. Mal., p. 371 (1886), type *calathus*, Hew.

LOTONGUS CALATHUS.

Endamus calathus, Hew., Ann. and Mag. N. H. (4), xviii, p. 353 (1876).
Lotongus calathus, Elwes and Edwards, Trans. Zool. Soc., xiv (4), p. 231 (1897).
Hesperia parthenope, Plötz, Stett. ent. Zeit., xlvii, p. 91 (1886), pl. 1365, ♂.
Hesperia parthenope, Weymer, Stett. ent. Zeit., xlviii, p. 17, pl. ii, f. 8, ♀ (1887).
Lotongus parthenope, de Nicév., Journ. Bomb. N. H. Soc., xiv (4), p. 354, pl. J, f. 4, ♂, 5, ♀ (1892).
Hesperia traviata, Plötz, l. c., p. 91, pl. 1366, ♀.
Lotongus maculatus, Distant, l. c., p. 372, pl. xxxv, f. 1 (1886).
Plesioneura aliena, Staud., Iris, ii, p. 155 (1889).
Proteides zalates, Mab., Ann. Soc. Ent. Belg., xxxvii, p. 52 (1893).
Proteides surus, Mab., Bull. Soc. Ent. Fr., 1895, p. lix.

Nias, Sumatra (*Plötz*).

Hewitson's type came from Sumatra. I agree with Elwes that this is a variable species; it has also been recorded from the Philippines, Kina Balu, Malacca, Borneo, and Java. Plötz's figure of the male has only the spot at the end of the cell and two outside it, and on the underside, in addition to the discal band of spots, there is only one spot at the end of the cell, none above it; in the female there is a bifid larger spot at the end of the cell, and two beyond it, and on the underside a similar spot above, and one elongated spot below on the hinder margin; in neither sex is there any white at the apices of the hind-wings below. I have the species from Nias, but in my examples there is a white, narrow, apical space on the hind-wings below.

UNKANA, Distant, Rhop. Mal., p. 369 (1886), type *batara*, Distant.

Unkana attina.

Hesperia attina, Hew., Trans. Ent. Soc. (3), ii, p. 489 (1866), ♀.
Unkana attina, Distant, l. c., f. 30.
Unkana attina, Elwes and Edwards, Trans. Zool. Soc., xiv (4), p. 234 (1897).
Hesperia latreillei, Felder, Reise Nov. Lep., iii, p. 511, pl. lxxi, f. 8 (1866), ♀.
Hesperia anitta, Plötz, Stett. ent. Zeit., xliii, p. 337 (1882), ♂, pl. 1374.
Ismene batara, Moore, MS., Cat. Lep. E. I. C., i, p. 249 (1857), ♂.
Unkana batara, Distant, Rhop. Mal., p. 370, pl. xxxiv, f. 11, ♂ (1886).

Habitat unknown (*Plötz*).

Recorded from the Philippines, Java, Malacca, Perak, and Moulmein, and in my own collection from Kuching, Borneo.

The ground colour of the hind-wings below in Plötz's figure is not white enough, but it unmistakably represents this species.

SABERA, nov.

Palpi upturned thickly hairy, antennæ two-thirds the length of the costa, club rather long and even, not thick, apiculus short and curved, fore-wing narrow, costa very slightly curved, apex bluntly acute with outer margin oblique, hind margin straight and less than two-thirds length of costa, hind-wing with the outer margin evenly rounded, legs slender, hind-legs with long hair on the inner side, mid tibiæ with one pair spurs, hind tibiæ with two pairs; fore-wings with vein 2 from about the middle of the cell, 3 from before the lower end, 4 from the end, 5 below the middle of discocellular, 6 and 7 from upper end, 8 from close to upper end, 12 ending on costa well beyond upper end of cell, hind-wings with vein 4 from end of cell, 2 and 3 from close before end at equal distances apart, 5 from the middle of discocellular, 6 and 7 from upper end, 8 coincident with 7 for a short distance from the base, then well separated.

Type *cæsina*, Hew.

Sabera cæsina.

Hesperia cæsina, Hew., Trans. Ent. Soc., iii (2), p. 491 (1866).

Hesperia æsina, Hew., Ex. Butt. V. Hesp., pl. 6, f. 57 (1873).

Waigiou (*Hewitson*).

I have this from Brunei, N. Borneo, Gennan, New Guinea, Humboldt Bay, and Cairns, Queensland; the females appear to have the white discal macular band of the fore-wings narrower and less complete than the males.

EETION, de Nicév., Journ. Bomb. N. H. Soc., lx (4), p. 395 (1895), type *elia*, Hew.

Eetion elia.

Hesperia elia, Hew., Trans. Ent. Soc. (3), ii, p. 489 (1866).

Unkana elia, Distant, Rhop. Mal., p. 370, pl. xxxiv, f. 25 (1886).

Hesperia eburus, Plötz, Berl. ent. Zeit., xxix, p. 226 (1885), pl. 1373.

Malacca (*Plötz*), type in coll. Erhardt.

ZEA, Distant, Rhop. Mal., pp. 369 and 377 (1886), type *mytheca*, Hew.

Zea taprobanus.

Hesperia taprobanus, Plötz, Berl. ent. Zeit., xxix, p. 226 (1885), pl. 1371.

Hesperia taprobanus, Plötz, Stett. ent. Zeit., xlvii, p. 92 (1886).

Zea mythecoides, de Nicév., Journ. Bomb. N. H. Soc., xii (1), p. 157, pl. AA, f. 33, ♂, 34, ♀ (1898).

Ceylon (*Plötz*), type in coll. Erhardt.

Plötz's figure is very similar to de Nicéville's ♂ figure; de Nicéville's examples came from South Celebes; he states, "Described from three males and one female received from the capturer Herr C. Ribbe, who calls it *Pamphila taprobana*, a species unknown to me." I have two males from the same locality.

PLOETZIA, Saalm., Lep. Madag., i, p. 115 (1884), type *amygdalis*, Mab.

Systole, Mab., Lep. Madag., i, p. 330 (1885), type *amygdalis*, Mab.

PLOETZIA FIARA.

Proteides fiara, Butler, Trans. Ent. Soc., 1870, p. 503.
Hesperia fiara, Plötz, Stett. ent. Zeit., xliii, p. 314 (1882), pl. 255.
Ploetzia fiara, Holland, P. Z. S., 1896, p. 94.

S. Africa (*Plötz*).

On the plate is "*natalica*, Plötz," but he published the species as *fiara*, Butler, having found out his mistake before going to press; on the plate is written in pencil "= *fiara*."

PLOETZIA NIVEICORNIS.

Hesperia niveicornis, Plötz, Stett. ent. Zeit., xliv, p. 3 (1883), pl. 1390.
Baoris niveicornis, Holland, P. Z. S., 1896, p. 71.
Perichares albicornis, Butler, P. Z. S., 1896, p. 132, pl. vi, f. 8.

Angola (*Plötz*).

Butler's type came from Lower Nyika; it is much like Plötz's figure, and if not identical, it is certainly a race of the same species.

ISMENE, Swainson, Zool. Ill., i, pl. 16 (1820), type *œdipodea*, Swainson.

ISMENE NESTOR.

Ismene nestor, Mösch., Verh. Zool.-bot. Gess. Wien., xlviii, p. 208 (1878).
Ismene firdusi, Plötz, MS., pl. 1153.
Ismene ionis, de Nicév., Journ. Bomb. N. H. Soc., ix (4), p. 403, pl. Q, f. 61, ♂ (1895).
Ismene ionis, Elwes and Edwards, Trans. Zool. Soc., xiv (4), p. 295 (1897).

"Ostindien" (*Plötz*).

Möschler also records it from Java, de Nicéville from Sambawa and West Java; Plötz figured it under the name *firdusi*, but did not describe it, having discovered it was Möschler's species. "Ostindien" in continental language is Java.

ISMENE ŒDIPODEA.

Ismene œdipodea, Swainson, Zool. Ill., i, p. 116, pl. xvi (1820).
Ismene consobrina, Plötz, Stett. ent. Zeit., xlv, p. 55 (1884), pl. 1187.

Java (*Plötz*).

The female has a rather bright patch of blue-green in the middle of both wings towards the base; the thorax and basal portions of the abdomen are covered with hairs of the same colour; both types were females. There are several examples of both sexes from Java in the B. M. and in my museum.

ISMENE LUSCA. Pl. III, fig. 4.

Ismene lusca, Swinhoe, Ann. Mag. N. H. (7), xx, p. 434 (1907).

Maros, S. Celebes, type in B. M.

BURARA, Swinhoe, Trans. Ent. Soc., 1893, p. 329, type *vasutana*, Moore.

BURARA RADIOSA. Pl. III, figs. 5, 6.

Ismene radiosa, Plötz, Berl. ent. Zeit., xxix, p. 232 (1885), pl. 1588.

Celebes (*Plötz*), type in coll. Erhardt.

Nearer *I. lara*, Leech, from China, than any other species known to me.

HASORA, Moore, Lep. Ceylon, i, p. 159 (1881), type *badra*, Moore.

PARATA, Moore, l. c., p. 160, type *chromus*, Cram.

HASORA CERTHIA. Pl. III, figs. 7, 8.

Ismene certhia, Plötz, Stett. ent. Zeit., xlv, p. 59 (1884), pl. 1172 ♂ ♀.

Philippines (*Plötz*).

There is a female from Mindoro in the B. M.; it differs from *badra*, Moore, from India in very much the same manner as *anura*, de Nicéville; its anal lobe is more pronounced than in *anura*, but is very much less than it is in *badra*.

HASORA GNÆUS.

Ismene gnæus, Plötz, Stett. ent. Zeit., xlv, p. 58 (1884), pl. 1171.

Hasora gnæus, Semper, Schmett. Philipp., p. 290 (1892).

Hasora gnæus, Elwes and Edwards, Trans. Zool. Soc., xiv (4), p. 298 (1897).

Ismene badra, var. *celebica*, Staud., Iris, ii, p. 138 (1889).

Philippines (*Plötz*), type in coll. Erhardt.

Very closely allied to *H. badra*, Moore, only differing in the two white spots on the hind-wings below being much larger; I have examples from Brunei, N. Borneo, with the white spots on the hind-wings below quite as large as those figured in Plötz's plate, received with a number of ordinary *badra* from the same locality.

Hasora simplicissima.

Ismene simplicissima, Mab., Bull. Soc. Ent. Fr. (5), vi, p. xxv (1876).

Hasora simplicissima, de Nicév., Journ. Bomb. N. H. Soc., ix (4), p. 405, pl. Q, f. 62, ♂, 63, ♀ (1895).

Ismene philetas, Plötz, Stett. ent. Zeit., xlv, p. 55 (1884), pl. 1159.

Hasora badra, Distant (nec Moore), Rhop. Mal., p. 374, pl. xxxv, f. 3 (1886).

Hasora hadria, de Nicév., Journ. Bomb. N. H. Soc., iv, p. 172 (1889).

Philippines (*Plötz*).

Plötz must have made his drawing from a damaged specimen, a male, there being no anal lobe, but the underside corresponds with de Nicéville's figure. There can be no doubt that these are all one species, it is fairly common in many of the Islands; it has also been recorded from Bali, Sumatra, Malacca, and Burma; I have it also from Java.

Hasora mimosa. Pl. III, fig. 2.

Hasora mimosa, Swinhoe, Ann. Mag. N. H. (7), p. 435, (1907).

Borneo, two examples (*Crowley bequest*), type in B. M.

Hasora chabrona. Pl. II, fig. 3.

Ismene chabrona, Plötz, Stett. ent. Zeit., xlv, p. 5 (1884), pl. 1590.

Hasora chabrona, de Nicév., Journ. Bomb. N. H. Soc., ix (4), p. 406 (1895).

Malacca (*Plötz*).

The figure well represents the common Eastern *Hasora*, and de Nicéville's remarks on the subject appear to me to be absolutely correct; I have it from the Philippines, Sumatra, N. Borneo, Ceylon, Perak, Tonkin, Bombay, Lanaoli, Poona, and Cherra Punji. It is quite distinct

from *vitta*, Butler, as stated by de Nicéville; of this form I have examples from Labuan, Kina Balu, and Brunei, Borneo; it is uniformly a good deal larger, and has no spots on the fore-wings above or below.

HASORA WORTHA. Pl. II, fig. 5.

Hasora wortha, Swinhoe, Ann. Mag. N. H. (7), xx, p. 435, (1907).

Java (*Crowley bequest*), type in B. M.

HASORA HABROA. Pl. II, fig. 4.

Hasora habroa, Swinhoe, Ann. Mag. N. H. (7), xx, p. 436 (1907).

Celebes, type in B. M.

HASORA MEALA. Pl. II, fig. 6.

Hasora meala, Swinhoe, Ann. Mag. N. H. (7), xx, p. 437 (1907).

Celebes (*Wallace*), type in B. M.

HASORA CELÆNUS.

Papilio celænus, Cram., Pap. Exot., iv, pl. 393, f. A, B (1782).

Ismene salanga, Plötz, Berl. ent. Zeit., xxix, p. 232 (1885), pl. 1592.

Malacca, Aru (*Plötz*), type in coll. Erhardt.

Plötz's figures (two) represent this species very well; I have it from Amboina, where Cramer's type came from; de Nicéville records it from Sumatra.

HASORA LIZETTA. Pl. III, fig. 12.

Ismene lizetta, Plötz, Stett. ent. Zeit., xlv, p. 59 (1884), pl. 1157.

Java (*Plötz*).

Figured and described by Plötz from a specimen in Mus. Berlin, No. 5177; without examining the type specimen it is impossible to say what it is, but it looks suspiciously like an example of *H. celænus*, Cram., which de Nicéville recorded from Sumatra in Journ. As. Soc.

Beng., 1895, p. 554, with the inner portion of the purplish colour on the wings below rubbed out; however, there are no brands shown in the male and no shadings on the wings below.

Explanation of Plates I—III.

[*See Explanation facing the* Plates.]

II. *Notes on some* Butterflies *taken in* Jamaica. By G. B. Longstaff, M.D., F.R.C.P., F.E.S.

[Read November 6, 1907.]

The island of Jamaica is 144 miles long by 49 miles wide, and comprises an area of 4207 square miles, so that it is about equal to the counties of Devon and Somerset taken together. It lies well within the tropics, being between the latitudes 17° 45′ and 18° 35′ N.

Rather more than half the total area of the island is below the 1000 feet contour line, but some 60 square miles have an altitude of 4000 feet and upwards, the highest point reached by the Blue Mountains being 7360 feet.

My most remote points were separated by 120 miles of longitude, and 40 miles of latitude, but though I spent three weeks at an elevation of 2000 feet and upwards my highest point was but 2900 feet.

As regards geological formations, I collected upon almost all those of which the island is made up, with one important exception—I did not explore the Blue Mountains, indeed there seemed to be little to induce one to do so at that time of the year.

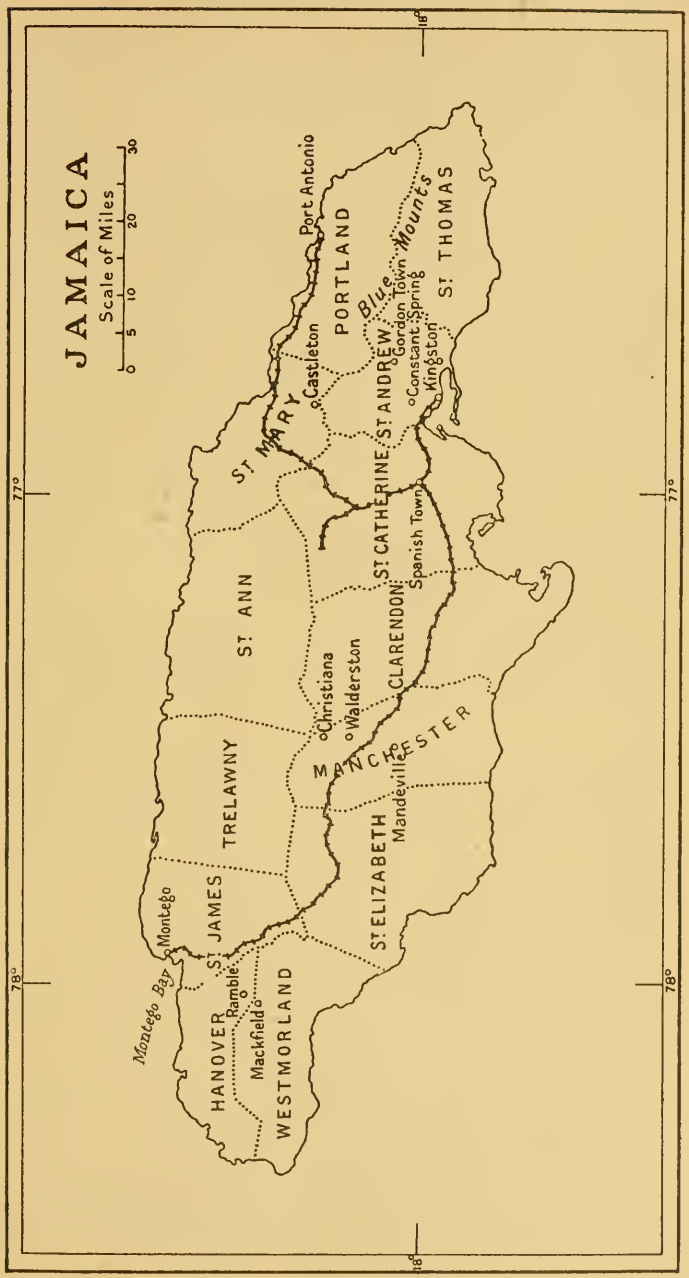
My remarks naturally enough apply to the places that I have visited, and to the times of my visits, limitations which should not be forgotten. My collecting was confined to ten weeks (Dec. 31—March 8) of the dry season, the tropical winter. However, the general aspect of the country towards the end of the dry season does not suggest to the English visitor either winter or early spring, but rather a fine, hot, late autumn, with burnt-up, gone-to-seed herbage and falling leaves. The quiet and solitude of the woods was surprising, so that the falling of a big leaf, such as are common in the tropics, would make clatter enough upon the path to give one a start. Often where trees and varied undergrowth little disturbed by cultivation suggested a profusion of insects, almost none were found. Not only were butterflies scarce, but beetles, bees, wasps, and especially flies. There is a note in my diary for Febr. 16th: "Christiana. Caught a wasp, the first I had seen since Constant Spring" (Jan. 14). During

that month I took but about half-a-dozen flies. Mr. H. P. Gosse, in his altogether admirable "Naturalist's Sojourn in Jamaica," expresses his surprise at the scarcity of insects, in words that seem to merit quotation. "I had left England with high expectations of the richness of the West Indian entomology: large and gaily-coloured beetles, I supposed, would be crawling on almost every shrub, gorgeous butterflies be filling the air, moths be swarming about the forest-edges at night, and caterpillars be beaten from every bush. These expectations were far from being realised: . . . in general butterflies are to be obtained only casually. Moths are still more rare . . . in general beetles and the other orders are extremely scarce, and especially Diptera; I have often been astonished at the paucity of these, as compared with their abundance in Canada and the Southern United States. . . . One may often walk a mile,—I do not mean in the depth of the forest, but in situations comparatively open, beneath an unclouded sun,—and not see more than a dozen *specimens* of all orders" (pp. 94, 95).

I was told that something between sixty and seventy species of butterflies occur in Jamaica, and it is a surprising fact that such a large tropical island should not produce more species than Great Britain. During my ten weeks' collecting I obtained forty-seven species, as compared with thirty-six species that are to be found in the one Devonshire parish of Mortehoe. Indeed for the most part I found Jamaica poorer in butterflies than Mortehoe in the summer. There were but two occasions on which the numbers were comparable, both near Port Antonio.

On the afternoon of February 25th I was ferried over to Navy Island. The Trade-wind was blowing rather strongly, and the only sheltered spot was some swampy ground to the leeward of a bluff; here *Anartia jatrophæ*, Linn., was in the greatest profusion, many being busy about the flowers of the Logwood-trees (*Hæmatoxylon campeachianum*, Linn.), with them were a few *Dione vanillæ*, Linn., and one *Precis lavinia*, Cram.

The other time was on March 3rd, near the top of "Shotover," to the west of Port Antonio. Here, about 1000 feet above sea-level, on a spur of a somewhat higher hill, commanding a glorious view of sea and coast, was a steep slope with an aspect a little south of east. An acre or two of this slope, partly sheltered by trees,


JAMAICA
Scale of Miles
0 5 10 20 30
77°
78°
18°
Port Antonio
Castleton
PORTLAND
Blue Mounts
ST THOMAS
ST MARY
ST ANDREW
Gordon Town
Constant Spring
Kingston
ST CATHERINE
Spanish Town
ST ANN
CLARENDON
Christiana
Walderston
MANCHESTER
Mandeville
TRELAWNY
ST ELIZABETH
ST JAMES
Montego
Montego Bay
HANOVER
Ramble
Mackfield
WESTMORLAND

displayed a greater wealth of flowers than I saw anywhere else in Jamaica, the dominant and most attractive being a species of Vervain (probably *Stachytarpha jamaicensis*, U.). It was a very hot day, with less wind than usual, and I was there from 11.15 a.m. to 12.30 noon. *Dione vanillæ* was fairly swarming, while *Euptoieta hegesia*, Cram., was scarcely less abundant, and among them were numerous *Precis lavinia*, Cram., and a few Skippers, *Prenes nyetelius*, Latr., *P. ares*, Feld., and *Morys valerius*, Mösch. *Callidryas eubule*, Linn., was coursing about in all directions, often stopping to take a sip from the Vervain; but not a single White was seen; *Colænis* was conspicuous by its absence, while *Anartia jatrophæ*, Linn., if present did not obtrude itself on my notice. A hasty glimpse of a *Papilio* was obtained, also of a butterfly that suggested my South African acquaintance, *Planema esebria*, Hew. (? *Actinote* sp.). Among the butterflies were a few of the beautiful Arctiid, *Utetheisa bella*, Linn. (*speciosa*, Walk.). Altogether it was such a sight as seldom gladdens the eye, but which happily lingers long in the memory.

A few words on the localities visited :—

Constant Spring (Dec. 31—Jan. 14); the hotel stands near the northern edge of the Liguanean plain, about 500 feet above the sea. There is good collecting in the woods at the foot of the mountains up to Stoney Hill, say 1000 feet.

Gordon Town (Jan. 9); the bed of the Hope River below the town, which I visited once, is about 800 feet.

Chancery Hall (Jan 8, also March 7), on the plain, is beside the dry bed of a stream, to the west of Constant Spring.

Temple Hall (Jan. 11, 12), c. 850, is on the road to Castleton, Jamaica.

All these places are in St. Andrew Parish. Parishes in Jamaica take somewhat the place of counties in England, and as the names are in constant use it seems well to give them.

Castleton, St. Mary Parish (Jan. 11, 12), is just beyond the height of land; the Botanic Garden is 500 feet above the sea. It proved a disappointing locality.

Mandeville, Manchester Parish (Jan. 16–22), ranges from 2000 feet to about 2200 feet. It proved very poor.

Mackfield and Ramble, close together, the former in Westmoreland, the latter in Hanover (Jan. 24—Feb. 2).

A delightful rolling country of pasture intermixed with woods. About 800–1000 feet. Unfortunately the very head-quarters of the collector's greatest foe in Jamaica—the tick.

Montego Bay, St. James (Feb. 2–5); the collecting ground ranges from the sandy shore to the top of a wooded hill of about 300 feet, and was fairly productive.

Walderston, Manchester (Feb. 6–20); the collecting ground ranged from about 2500 feet to 2900 feet (Mile Gully Mountain). An almost waterless district, but the tops of the hills covered with woods. One day (Feb. 16) was spent at Christiana in a gorge cut through Trappean Conglomerate, about seven miles to north of Walderston. Height about 2000 feet in a well-watered country.

Spanish Town, St. Catherine (Feb. 20–23); near the edge of an extensive plain, its elevation above the sea must be inconsiderable.

Port Antonio, Portland (Feb. 24—March 5); from the coast my collecting ground extended to the summits of "Shotover" on the west and Park Mount on the east, both about 1000 feet.

Speaking generally, insects were commonest near the sea and on the slopes of the hills up to 1000 feet. Flies, bees and wasps were especially scarce at 2000 feet and over.

DANAINÆ.

Anosia archippus, Fabr., 4 ♂. Only seen at Port Antonio. Found about *Asclepias* also at Rose and other flowers; it is hard to kill.

The Jamaican specimens of this butterfly differ from those from South America in the following particulars. They are brighter; they have less black along the veins; there is more fulvous at the tip of the fore-wing; the white spots beyond the cell are outlined (and sometimes suffused) with fulvous.

Tasitia jamaicensis, Bates. 2 ♀ near the stream which the Kingston-Castleton road crosses close by Temple Hall; a ♂ near Ramble Post Office, another ♂ near Walderston. Like the preceding, this is hard to kill.

The form met with on the mainland, *T. eresimus*, Cram., which appears to be distinct, has much more black about it, *e.g.* along the costa and the veins.

Mr. P. W. Jarvis said to me: "Neither of the Milkweed Butterflies is very common in Jamaica."

SATYRINÆ.

Calisto zangis, Fabr. 26 specimens. Very generally distributed in woods, but seldom abundant. Constant Spring, Castleton, Mandeville, Mackfield (common), Walderston (common), Port Antonio (abundant). The sexes about equally divided. It flies amongst herbage so close to the ground as to be difficult to catch, yet seldom moving many yards. It is distinctly a shade-lover. On 27th February, 1907, near Port Antonio, I saw it flying freely on a rainy day.

HELICONINÆ.

Heliconius charithonia, Linn. 21 specimens. Generally distributed throughout the island and not uncommon. Constant Spring, Castleton (common), Mackfield, Walderston, Christiana, Montego Bay, Port Antonio (common).

This butterfly has usually a slow flapping flight often in half-shade. It is distinctly local, in the sense that it is confined to a very small area in each locality; sometimes it may be seen flying up and down a very short beat. It settles on flowers and leaves with wings fully expanded.

Mr. P. W. Jarvis, of the Colonial Bank, told me that the butterfly was very common later in the year, and that it "clustered" on going to rest for the night; a number of specimens sitting close together, but not actually clinging to one another. On 5th March, 1905, at "Shotover," near Port Antonio, close upon 1000 feet above the sea, at about noon on a dull day, eight or ten were seen flying about under the shelter of a hedge. As many as seven of these settled on dead sticks, etc., within a space of 2 feet by 1 foot. This butterfly is somewhat hard to kill.

As compared with Venezuelan specimens, those from Jamaica have all the yellow marks a little larger; and the red spot near the base of the cell of the hind-wing is smaller, or even absent.

NYMPHALINÆ.

Colænis cillene, Cram. (should not the name be *cyllene*?), 12 ♂, 4 ♀. Generally distributed and not uncommon. Constant Spring (common), Castleton (common), Mackfield, Montego Bay, Walderston, Port Antonio.

A grand insect on the wing, sailing about like a piece of rich gold. The imperfect condition of many of the specimens is not apparent during its strong flight. It is

most easily taken at flowers such as *Lantana camara*, Linn., and *Eupatorium odoratum*, Linn. One specimen appears to have been bitten by a lizard.

The male is distinguished from that of the South American *C. delila*, Fabr., by its more orange tint and the comparative absence of black; but *cillene* should perhaps be looked upon as a local race of *delila*.

Dione vanillæ, Linn. 16 ♂, 7 ♀ Generally distributed and in some places very abundant. Constant Spring (common), shore of Port Royal harbour, Mandeville (abundant), Ramble (abundant), Montego Bay, Walderston, Spanish Town, Port Antonio (swarming on "Shotover").

A brilliant insect appearing very red upon the wing and reminding me of an *Acræa*. Although it could fly about wildly enough, several males were seen one afternoon fluttering among dead leaves close to the ground.

I do not detect any difference between Jamaican and South American specimens, save that the former are usually smaller and often brighter.

Euptoicta hegesia, Cram. 12 specimens. Widely distributed but in most places scarce. Constant Spring, Temple Hall, Montego Bay (common near the hotel, also found on the sandy shore), Walderston, Port Antonio (common in a swampy meadow near the shore to the east, but in swarms on the top of "Shotover").

This insect reminded me of *Atella phalanta*, Drury.

Jamaican specimens have the orbicular and reniform stigmata less clearly outlined than those from the Spanish main; moreover the ground-colour is a brighter tawny.

Phyciodes frisia, Poey. 5 specimens. This little butterfly was confined to the Liguanean plain and the hills bounding it on the north, and was not common.

Constant Spring, Stoney Hill, near Gordon Town, Spanish Town.

Precis lavinia, Cram. 8 specimens, all males. Constant Spring, Chancery Hall, Mandeville, Port Antonio. It usually settles on or near the ground, frequenting hot, dry, exposed places. Is wary and not easy to catch.

The nomenclature of this very variable and wide-ranging species (from the Southern United States to the Argentine) has long been in great confusion, but has been cleared up by Mr. Guy A. K. Marshall, who has recently re-arranged the genus in the National Collection. Cramer

named three forms of this genus, all from Surinam, *lavinia*, *evarete* and *genoveva*. It appears to me that Mr. Marshall is quite correct in uniting these under the first name, together with the Northern form *cœnia*, Hübn. (the name adopted by Messrs. Godman and Salvin in the "Biologia Cent. Am.").

Jamaican specimens, usually known by local collectors as *Junonia genoveva*, Cram., are, as a rule, brighter than South American, with the transverse white band near the tip of the fore-wing fairly conspicuous, being of the form *zonalis*, Feld.* They are somewhat intermediate in character, between the South American and North American forms, to which latter specimens in the Hope Collection from the Bahamas approach more nearly.

Anartia jatrophæ, Linn., var. *jamaicensis*, Möschler. 8 ♂, 7 ♀. Widely distributed and abundant. Constant Spring, Castleton, Mandeville, Mackfield, Montego Bay, Walderston (scarce), Christiana, Port Antonio.

It is *par excellence* the common road-side Butterfly of Jamaica. A somewhat ghostly looking insect on the wing; when settled among whitish dead grass, with wings closed, it is very cryptic. It usually settles on the ground or close to it and does not frequent flowers much.

Jamaican specimens are all very readily distinguished from those from South America by the broad bright fulvous, or orange brown, margin to the wings. There is a mere trace of this colour in specimens from the mainland, which moreover appear to be less densely scaled.

Cystineura dorcas, Fabr. (*mardania*, Cram.). 22 specimens. Local; Constant Spring, Gordon Town, Mackfield (abundant), Williamsfield Cave, Montego Bay, Port Antonio (common).

This delicate and very distinct butterfly, which somewhat resembles a Satyrid, frequents moist, shady places with long grass. There is sometimes much fluttering in its very slow flight, but at other times it glides. Though not such a flower-lover as many Nymphalines, it often visits the Spanish Needle, *Bidens leucanthus*, W. It usually settles with its wings wide open, and if it close them up re-opens them quickly. On 1st February, 1907,

* H. Fruhstorfer (Stett. Ent. Zeit. 1907, p. 224) comes to the same conclusion as Marshall as to Cramer's three forms, but makes the Cuban form (*zonalis* according to Marshall) a new sub-species *michælisi*.

near Chichester Rectory, Ramble, two were beaten out after sundown; both settled almost at once, one on the top of a grass stem with its wings up, the other towards the top of a long green fern. The second very deliberately set up its wings, then after an interval it retracted its fore-wings so as to conceal the large white patch. I failed to find any naturally at rest.

It may be noted that *C. cana*, Erichs., the representative of *C. dorcas* on the mainland, lacks the conspicuous orange brown of the latter species.

Victorina stelenes, Linn. (So spelled by Linné; Mr. Kirby has it *steneles*; probably Linné meant to call it after either Sthenelus or Sthenele, the other names are meaningless.) 11 specimens. Widely distributed, but not common. Constant Spring, Mackfield, Walderston, Christiana, Spanish Town, Port Antonio. On the banks of the Rio Grande, on 2nd March, I saw four or five flying together about a bush of what I took to be the Rose Apple (*Jambosa vulgaris*, D.C. = *Eugenia jambos*, Linn.).

Cabinet specimens give little idea of the beauty of this butterfly during life, since its lovely green fades rapidly. Bold, like many of its family, it will return again and again to the same perch, often a dark-green leaf at or above the level of the eye. Sitting there with its wings three-quarters open it is a truly beautiful object, yet not nearly so conspicuous as might be thought, and this is true whether its wings be open or closed, whether at rest or in its rather slow flight. One courageous specimen settled first at my feet and then upon my net!

In Jamaican specimens the fulvous spot at the anal angle of the hind-wing is larger and brighter than in South American; there is also somewhat more fulvous on the underside, the bands being broader.

Aganisthos orion, Fabr. (*odius*, Fabr.). 5 specimens. This very fine and robust Butterfly was only met with to the west of Port Antonio near the sea-level.*

It is quite probable that sundry large brown butterflies

* Messrs. Godman and Salvin ("Butterflies of St. Vincent, Grenada, etc.," Proc. Zool. Soc. Lond. (1896), p. 515) say: "Grenada. Two specimens of this common species, which is also found in Hispaniola, but in no other West Indian island that we know of." It is, however, one of the few butterflies named by Gosse ("A Naturalist's Sojourn in Jamaica" (1851), p. 99).

seen at Ramble and Walderston may have belonged to this species or the next.

A strong flier frequenting the tops of trees, especially the Star Apple, *Chrysophyllum cainito*, Linn., on the leaves and fruit of which it occasionally settles. More frequently it is seen to rest on tree-trunks (in particular the Log-wood, *Hæmatoxylon campcachianum*, Linn.), on posts or buildings within a few feet of the ground, always with its head downwards and wings closed over its back. When thus settled it may be detected, when seen in profile, at a considerable distance in spite of its cryptic coloration. It is not easy to catch even when settled, and I spent much time over it. One of my specimens seems to show a bird-bite at the usual corner of the hind-wings.

In the Jamaican specimens the fulvous band across the fore-wing is much broader than in those from the main-land; there is also a tendency for the fulvous on the hind-wing to be more extended.

Cœa acheronta, Fabr. (*cadmus*, Cram.). A broken fore-wing of this species was picked up off the ground in a wood above Constant Spring, January 5th, 1907.

The Haïti specimens in the Hope Collection are more fulvous than those from the mainland, and this fragment appears to be of Haïtian type.

LYCÆNIDÆ.

Leptotes (*Tarucus*) *theonus*, Lefebre, 1856 (*Plebeius cassius*, var. a, *floridensis*, Morrison, 1874), 8 ♂, 19 ♀. Met with in every locality that I visited: common at Mackfield; abundant at Constant Spring, Gordon Town and Port Antonio. The excess of females taken may be attributed to its superior size and attractiveness, but possibly it is easier to capture. It is most often seen flying over shrubs or near woods; it has a quick jerky flight and appears larger than it is, especially the female. After rain it is about the first butterfly to come out.

All my specimens taken in Jamaica are distinguishable at a glance from those taken in South America, Trinidad or Tobago. They are smaller and darker; the hind-wing of the male is violet-blue instead of white; the fore-wing of the female is shot with blue over at least two-thirds of the fore-wing, and there is much less white in the hind-wing. On the underside the metallic-centred ocellus is larger, and there are differences in the dark markings of the fore-wing.

In my opinion it is specifically distinct from *S. cassius*, Cram., but if not distinct it is a very well-marked local race. The earliest description of the form that I can find is that by Lefebre in Ramon de la Sagra's "Histor. Cuba," VII, p. 611, and it should, I think, bear his name. It appears in W. Holland's "Butterfly Book" as *Lycæna theonus*, Lucas.

Catochrysops hanno, Stoll (? *monops*, Zeller). 11 specimens. Abundant at Constant Spring, also met with at Mackfield, Walderston and Port Antonio. Its small size and insignificant appearance probably often cause it to be passed over. It frequents small Composites by the roadside, especially *Distreptus spicatus*, Cass.

Callipsyche thius, Hübn. A single very fine male near the Jam Factory, at the foot of the hills, Constant Spring. On the wing I took it for a Skipper. This and the specimens from Jamaica in the National Collection lack the white mark at the tip of the fore-wing of the male met with in Venezuelan examples.

Calycopis pan, Drury. Three specimens, taken in the garden at Walderston by my Portuguese servant. The lobes of the hind-wings are everted as in the Indian *Aphnæus* and the South African *Argiolaus*.

PIERINÆ.

Callidryas eubule, Linn. (f. *sennæ*, Linn.). 17 ♂, 14 ♀. Constant Spring (common), Gordon Town (abundant), Castleton, Temple Hall (abundant), Mandeville, Mackfield (common), Montego Bay (common), Walderston, Christiana, Spanish Town (abundant), Port Antonio (abundant).

If not actually the most abundant, at all events the most conspicuous butterfly on the island. Brilliant in colour, bold in flight, and numerous in individuals, it was always much in evidence.

The "dry" form prevailed, more especially as the season advanced.

Kricogonia lyside, Godt., 6 ♂, 2 ♀. Ramble, Montego Bay, Spanish Town, Port Antonio (not uncommon along the coast to the eastward).

Glutophrissa ? drusilla, Cram. Common at Constant Spring, also taken at Montego Bay. This species usually flies high, frequenting flowering trees and so out of reach. My specimens are small, especially the females, which are quite devoid of black markings. Somewhat similar

specimens from Jamaica and other islands were named by Mr. Butler *ilaire*, Godt., but the type of Godart's insect came from Brazil. In the museum at Kingston this bears the name *Appias poeyi*, Butl. It is perhaps the *Mylothris margarita* of Hübner. It would be interesting to see Jamaican specimens taken in the wet season, for the presumption is that mine are of the dry form.

Sphænogona adamsi, Lathy. Of this butterfly, so rare in collections, I was fortunate enough to secure a male and three females. One of the latter was taken near Constant Spring, the other three specimens on the Manchester Mountains, viz. one at Contrivance, about 2700 feet, the other two on Mile Gully Mountain at nearly the same elevation.

The solitary specimen in the National Collection is from "Kingston, Jamaica."

Terias euterpe, Ménét, 39 ♂, 21 ♀. The commonest species of the genus in Jamaica. Constant Spring (abundant), Gordon Town (not common), Castleton, Mandeville, Ramble (abundant), Montego Bay, Walderston (not common), Port Antonio (common).

As this little butterfly flits along close to the ground it appears to be easy to catch; however, it goes faster than one would think; its flight is jerky, and when struck at it almost always goes down into the herbage and so escapes the net again and again. This remark must be held to apply to several species of *Terias*, which were not always distinguished in the field.

A male was taken at Mackfield with a small symmetrical injury to each hind-wing.

Terias westwoodii, Boisd. (The Jamaican form, ? *dina*, Poey.) Three males, two females. Only met with at Montego Bay. It flies more freely and more strongly than the last.

The Jamaican specimens are small and pale: the black on the hind-margin (especially in the female) is limited to the tip of the fore-wing.

Terias messalina, Fabr., 10 ♂, 10 ♀. Constant Spring, Hotel Grounds and wood to N.E., Mackfield (common), Montego Bay, Spanish Town, Port Antonio.

Terias delia, Cram., 16 ♂, 14 ♀. Widely distributed, but not so common as *euterpe*. Constant Spring (common), Castleton, Mandeville, Mackfield, Montego Bay, Walderston, Port Antonio.

A male taken above Constant Spring at about 1000 feet elevation on January 1st; another male taken near Chancery Hall, 500 feet, on January 8th, approached the form *lydia*, Feld., in having the longitudinal black streak broader than usual. On the other hand, another male taken somewhat below the first named and on the same day has *no black streak* at all, merely the streak of orange.

Terias elathea, Cram., 3 ♂, 1 ♀. Scarce. Constant Spring, Montego Bay, Port Antonio (Shotover Hill).

This butterfly appears to be specifically distinct from *delia*, Cram., but is certainly very closely allied to it. The females are difficult to distinguish, and some specimens of the male sex not easy. In two males from Venezuela one has the black streak obsolescent, in the other entirely absent with indeed very little orange.

Pieris phileta, Fabr. (*monuste*, Hübn. et auct. *nec* Linn.), 4 ♂, 1 ♀. Only met with at Montego Bay, and at Contrivance, Walderston.

The flight of this butterfly is sometimes extremely swift, and it exercised my active Portuguese servant and myself very severely to secure three specimens near the shore of Montego Bay. Sometimes it may be taken at the flowers of *Eupatorium odoratum*, Linn. During life the clubs of the antennæ are of a beautiful turquoise blue.

PAPILIONINÆ.

Papilio polydamas, Linn. (f. *polycrates*, Hopff.). 7 specimens. Constant Spring (common), below Gordon Town, Spanish Town. Not seen on the high land.

Fond of flowers, especially *Bougainvillea*, fluttering as it feeds, as many of the family do. A specimen observed flying in deep shade about 5 p.m. settled on a dead leaf and closed its wings; the underside was distinctly cryptic.

All my specimens are of the insular form in which the marginal spots of the fore-wing are paler, those of the hind-wing greener, than in South American examples: the marginal pattern on the underside of the hind-wing is coarser, with more brick-red and more white in it.

HESPERIIDÆ.

Eudamus proteus, Linn. 9 specimens. Constant Spring, below Gordon Town, Port Antonio (common). Has a quiet flapping flight; at rest all its wings are nearly upright, but the fore-wings much sloped back, the *tails at*

right angles to the plane of the hind-wings. Frequents *Bougainvillæa* flowers.

Eudamas catillus, Cram. Two specimens, taken late in the afternoon in a wood at Montego Bay; flight not very swift.

Thymele grenadensis, Schaus. A very worn specimen, on the bank of the Rio Cobre, Spanish Town. It settled repeatedly on the same spot.

Telegonus hurga, Schaus. A worn specimen, in the Mahogany Wood, Rockalva, Ramble. It was very bold, returning again and again to rest on the same fallen tree.

Perichares corydon, Fabr. Two. Mackfield, Montego Bay.

Prenes nyctelius, Latr. Three. Mandeville, Port Antonio ("Shotover," East Harbour).

Prenes ares, Feld. One. "Shotover," Port Antonio.

Anastrus simplicior, Möschl. One. Cold Harbour, Port Antonio. Rests with the wings fully expanded.

Aeolastes amyntas, Linn. One, taken by Mrs. Longstaff in the Botanic Garden, Castleton.

Serdis aurinia, Plötz. One of each sex, taken at the foot of Park Mount, Port Antonio, about 2.30 p.m. A very distinct insect identified by Mr. H. H. Druce with Plötz' excellent figure of the male from a Jamaican specimen. The insect does not seem to be known in British collections. Mr. Godman ("Ann. Mag. Nat. Hist.," Aug. 1907) says of the figure that it probably belongs to *Limochares* or *Serdis*. Mabille places it in his genus *Serdis* under the heading "Species non visæ" (*Genera Insectorum*, Hesperidæ, p. 144).*

Ephyriades otreus, Cram. One specimen, near Chancery Hall, Constant Spring; settled on a projecting grass stem with wings fully expanded.

Hesperia syrichthus, Fabr. Twelve. Generally distributed over the Island, especially common at Mandeville and Port Antonio. A somewhat variable species within limits. It rests with the wings fully expanded.

Hylephila phylæus, Drury. Five. This brilliant little

* On April 5, 1908, Mr. H. H. Druce wrote saying that among some oddments in the British Museum he had come across the type of Butler's *Pamphila insolata*. (See Proc. Zool. Soc. Lond., 1878, p. 483). The specimen is from Jamaica (labelled *insolita*), and appears to be identical with my insects. Butler's name has priority since Plötz published his description in 1883.

golden Skipper was common near the shore, Port Antonio.

Catia drurii, Latr. Two. Below Gordon Town, c. 800 feet, and on the Park Mount Road, Port Antonio, c. 600 feet. Very hard to see. It rests with all the wings up, the fore-wings much sloped back.

Catia vesuria, Plötz. One, taken by my Portuguese servant in the garden at Walderston.

Morys valerius, Möschl. Four. Two above Constant Spring, c. 700 feet; two on "Shotover," Port Antonio.

Thymelicus vibex, Hübn. (The yellowest form is *combinata*, Plötz., H. H. Druce.) A female *came to light* at Montego Bay.

Cymænes silius, Latr. One, in the wood above the Jam Factory, Constant Spring.

I call attention to the number of species in which Jamaican examples differ from Venezuelan in the replacement of black or grey by fulvous, or orange brown. It is true that the soil of Jamaica, even where the formation is white coralline limestone, is often of an orange brown colour, but it scarcely seems possible to connect the two as cause and effect.

III. *On some of the* Butterflies *of* Tobago. By G. B. Longstaff, M.D., F.R.C.P., F.E.S.

[Read November 6, 1907.]

A glance at the map shows that this island stands outside the crescent of the Lesser Antilles, or Windward Islands, about 20 miles to the north-east of Trinidad in latitude 11° 15′ N. The southernmost of the Windward Islands proper, Grenada, is about 70 miles W.N.W. of Tobago. It is therefore pretty obvious that, geographically speaking, Tobago belongs to South America rather than to the West Indies. The mountains of the north-east coast of Venezuela, consisting for the most part of clay-slates and schists believed to be of Silurian age, run by way of the peninsula of Paria and the islets of the Bocas, along the northern coast of Trinidad, and would appear to be prolonged to the eastern half of Tobago.

In area Tobago is about equal to the county of London, comprising but 114 square miles, and therefore only about three-fourths of the size of the Isle of Wight, and only one-fifteenth of that of its neighbour. (Trinidad area, 1754 square miles = Lancashire.) The south-western portion of the island, which is low and more or less flat, is formed of coralline limestone, and is completely cultivated. The central and north-eastern portions are hilly, rising to 2000 feet, and in large part covered with forest, some of it virgin, but much of it of second growth, or "rastrajo." The destruction of the forest is proceeding apace.

My stay was limited to eight days, April 3–10, 1907, of which, thanks to the hospitality of the Hon. H. L. Thornton and Mr. G. H. Sworder, three were spent at their estate, "Cocoa Wattie," the remainder near the coast.

We found the neighbourhood of Scarborough, the capital, for some miles on either side of the town very dry and parched, though we were told that there had been "some nice showers at night" during March. The Trade-wind blows very strongly along the coast, a dry, hot wind which greatly increases the difficulties of the collector.

Cocoa Wattie is a plantation near the middle of the

island towards the confines of cultivation, lying about 550 feet above sea-level. The wooded banks of a small river and some swampy hollows clothed with coarse grass and thin scrub afforded the best collecting grounds, and yielded, as might have been expected, a somewhat different fauna from that of the coast. It rained heavily on April 8th.

Anosia archippus, Fabr. 3 ♂, 1 ♀. Rather common in the outskirts of Scarborough; one specimen at Cocoa Wattie. Those taken resemble the specimens from the mainland, though one individual, a ♂, approached Jamaican specimens in colouring.

Euptychia hermes, Fabr. (*camerta*, Cram.). 5. Abundant at Cocoa Wattie.

Euptychia hesione, Sulz. 6. Common at Cocoa Wattie. I have taken this species and the following flying during rain.

Heliconius hydara, Hew. 3 ♂, 2 ♀. Rather common on the river bank at Cocoa Wattie. All the specimens are small, three extremely small; four of them have the bluish gloss (as in the form *guarica*, Reak., though that is a larger insect) which Mr. W. J. Kaye associates with wet conditions.

Precis lavinia, Cram. (f. *zonalis*, Feld.). 2 ♂. An example taken near the coast of the dry form, but with the anterior ocellus on the hind-wing very small. (Mr. W. J. Kaye has two very dark specimens from Mexico in which this ocellus is altogether wanting; in the National Collection there is a specimen from Colombia in which there are *no ocelli* on the upper surface, and only faint indications of them beneath.) The Cocoa Wattie example is "intermediate," approaching the "wet" form. Both the specimens would probably be called by Mr. Godman *cœnia*, Hübn., and by West Indian entomologists *genoveva*, Cram.; I follow Mr. Guy A. K. Marshall's recent rearrangement of the splendid series at South Kensington.

Anartia jatrophæ, Linn. 3. On the coast, not common. Those taken are pale in colour and semi-transparent, of the mainland form.

Anartia amalthea, Linn. One at Cocoa Wattie. Messrs. Godman and Salvin * say of this species: "Barbados, a

* Godman and Salvin, "Butterflies of St. Vincent, Grenada, etc.," Proc. Zool. Soc. London, 1896, p. 515.

single specimen . . . not previously noted from any West Indian island."

Dynamine theseus, Feld. This pretty little butterfly was common both on the coast and inland. It has a rapid gliding flight, but otherwise has some of the habits of a Lycænid, thus it often settles with its head downwards, and more than once I saw it move its hind-wings rapidly immediately after settling; the insect was, however, too shy to enable me to make out the exact nature of this movement.

Cystineura cana, Erichs. Two specimens on the coast, and two at Cocoa Wattie. It has a gliding flight.

Leptotes (*Tarucus*) *cassius*, Cram. 2 ♂, 2 ♀. Of the mainland form, in which white prevails over blue. Rather common along the coast; three specimens were small, but one female was larger than usual.

Catochrysops hanno, Stoll. (? *monops*, Zell.). One specimen to the east of Scarborough.

Thecla beon, Cram. 4. One specimen on the shore to the south-west of the town at the flowers of the Sea-side Grape (*Coccoloba uvifera*, Jacq.); rather common at Cocoa Wattie, frequenting the flowers of a purple papilionaceous shrub.

Thecla politus, H. H. Druce. A ♀ at Cocoa Wattie.

Thecla nubes, H. H. Druce, n. sp. One specimen at the Sea-side Grape, near Hillsborough; four at Cocoa Wattie at the pink flowers of a creeper.*

Callicista bubastus, Cram. (*salona*, Hübn.). One taken in Fort George, another at the flowers of the Sea-side Grape, near Hillsborough on the coast.

Terias nise, Cram., 3 ♂, 3 ♀, all of the "wet-season" form. Common near the coast.

Terias albula, Cram. 3. Near the coast, less common than the last; one taken two miles inland on the road to Cocoa Wattie.

Pieris phileta, Fabr. (*monuste*, Auct. *nec* Linn.). Two males under the coco-nut palms to the west of the town.

Callidryas eubule, Linn. (f. *sennæ*, Linn.). Abundant in Scarborough and along the coast towards the east, tearing about in all directions, but not at all common at Cocoa Wattie. Six ♂ and four ♀ taken, of these three were of the "wet-season" form, seven "intermediate," but all were

* H. H. Druce, Proc. Zool. Soc. Lond., 1907, p. 625.

very small. I noted that the males were attracted in numbers by the flowers of the Pineapple (*Ananassa sativa*, Lindl.) in the Government Botanic Station.

Phœbis agarithe, Boisd. 3 ♂, 1 ♀. Common to the east of Scarborough; very showy on the wing, though very difficult to catch, being not merely a strong flier, but also wary and seldom remaining on a flower for more than a few seconds, moreover it seems to like exposed places in the full blast of the Trade-wind. Those taken were all small, one male remarkably so; they are moreover much paler than specimens in the Hope Collection from Barbados and Venezuela.

Eudamus catillus, Cram. One small specimen on the shore to the west of the town.

Pyrrhopyge venezuelæ, Scudder. One at Cocoa Wattie.

Hesperia syrichthus, Fabr. Common on the coast; one example at Cocoa Wattie.

Callimormus corades, Feld. Three at Cocoa Wattie.

Systaeca crosa, Hübn. One at Cocoa Wattie. In this species the fore-wings are remarkably convex.

Epeus veleda, Godm. and S. One at Cocoa Wattie.

Megistias cortica, Plötz. (*epiberus*, Mabille.). One at Cocoa Wattie.

Cymænes silius, Latr. One at Cocoa Wattie. This species rests with the wings in the same position as our *Pamphila thaumas* and *P. sylvanus*.

Of the 28 species in this list, 24 * are known to Mr. Kaye as occurring in Trinidad; those not met with in both islands being *Phœbis agarithe*, *Theela nubes*, *Epeus veleda* and *Callimormus corades*. None of these is recorded by Messrs. Godman and Salvin from the Lesser Antilles.

As regards the general abundance of Butterflies, Tobago occupies a position between Jamaica and Trinidad. Whereas eight days' collecting in Tobago yielded 28 species, seven days' in Trinidad yielded 61; but it took ten weeks to get together 47 species in Jamaica. On the other hand, Venezuela proved much richer than any of these islands, for 135 species were collected in fifteen days.

In addition to the above I saw on the wing, about a mile from Cocoa Wattie, *Caligo* sp.; also Mr. Sworder gave me specimens of *Ithomia pellucida*, Hopff., and *Pteronymia asopo*, Feld., which he had taken at Cocoa Wattie, and he showed me specimens of other butterflies which I did not

* Of these 24 at least 19 also occur in Venezuela.

happen upon alive, including *Morpho* sp. The Hope Collection has *Terias westwoodii*, Boisd., from Tobago. Neither this last named nor *P. asopo* have as yet been recorded from Trinidad.

My cordial thanks are due to Prof. E. B. Poulton, F.R.S., and the assistants of the Hope Department, Oxford; to Mr. F. A. Heron and Mr. W. J. Kaye; and more especially to Dr. F. A. Dixey for naming the Pierines, and Mr. H. H. Druce for naming the Lycænids and Hesperids, and for describing a new species.

IV. *On the Metamorphoses of two* Hemiptera-Heteroptera *from Southern China.* By J. C. W. Kershaw, F.E.S., and G. W. Kirkaldy, F.E.S.

[Read February 5th, 1908.]

PLATES IV, V.

In the Transactions of this Society for 1907 (Part II) the metamorphoses of *Tessaratoma papillosa* were described by Kershaw and Muir. A similar paper by Kershaw and Kirkaldy on those of *Dindymus sanguineus* and *Cænocoris marginatus* will appear in the Journal of the Bombay Natural History Society, and the same authors now offer notes on the metamorphoses of *Chrysocoris stollii* and *Riptortus linearis.*

Chrysocoris stollii (Wolff).

This species has, so far as we are aware, been figured previously in the adult state only by Wolff (with his original description) and by Westwood (as *Callidea stockerus*, in his edition of Donovan's "Insects of China," Pl. 21, fig. 1 [1842]). It is distributed rather widely, from India to South China *via* Burma. It is also recorded from the Nicobars, Formosa and North China.

The female lays a batch of about a dozen eggs on leaves of many plants, among which the following seem to be the chief—

Glochidion obscurum, Bl.
G. eriocarpum, Champion } N. O. *Euphorbiaceæ.*
G. macrophyllum, Benth.
Psychotria elliptica, Ker., N. O. *Rubiaceæ.*

The nymphs and adults feed on the fruit of these plants; the newly-hatched nymphs would also accept *Lantana* berries and banana, though these are probably not their natural food.

Some females in captivity laid batches of eggs at intervals, but without the red markings (presently to be described), and none of these eggs hatched; there was no male with these females. Similar eggs, however (which

never hatched), were laid by a female after copulation. This failure was certainly not due to mites or mould, as the eggs remained firm and of fresh colour for several weeks. It is probable that the females copulate after each batch of eggs is laid.

The eggs are laid touching one another, and are pale hyaline-green, almost globular. A darkish-red marking like a small nail (thus T), and below this a curved red marking (thus ω), the two resembling an anchor. There is no peculiar cap to the egg, the hinge being merely indicated by a ring of minute protuberances like a string of pearls (Pl. IV, figs. 1 and 1*a*).

On the morning of August 28th, 1907, eleven ova were laid, and on the morning of the 30th a black mark showed on the centre of the curved red marking, the latter becoming slightly altered. The next morning the general colouring was yellowish, or pale pinkish-yellow, the red markings as before. The nymphs hatched the same afternoon, less than four days, remaining for several hours in a cluster on one side of the empty shells, eating nothing till after the first moult.

This first instar is shining black, with yellowish-white markings (Pl. IV, fig. 2).

The first moult took place on the afternoon of September 3rd, the metallic colouring then first appearing (fig. 3).* The nymphs then separated to feed, re-forming in a semicircular cluster at night. These young nymphs stand up very high on their legs.

The second moult took place on the 12th (fig. 4), and the third on the 21st September, and soon after the few remaining ones died. Fig. 5 represents the penultimate (?) nymphal instar of a closely allied species, while fig. 6 shows the final nymph of *C. stollii*, the adult being shown at figs. 7 and 8.†

The adults have a strong, disagreeable smell. They fly well, but rather heavily, and are common in wooded places and jungle during the wet season, though they are to be found throughout the year. During the dry season on very cold days they hide away under leaves, etc., often creeping between leaves which a spider has fastened together.

* They are pale red for a few minutes after the moult.

† The pronotum is a little foreshortened in fig. 7, the lateral margins of the pronotum being straighter.

Riptortus linearis (Linné).

This species is widely distributed from India to China *via* Burma, and from Ceylon through the Indo-Malayan Archipelago. It has been figured only in Herrich-Schäffer's "Wanzenartigen Insekten" (vol. viii, fig. 867), a rare work.

Riptortus linearis is apparently entirely vegetarian, feeding on the seed-pods of various *Leguminosæ*, etc., principally *Cassia occidentalis*, Linné, *Desmodium pulchellum*, Benth., and *Pueraria phascoloides*, Benth.

The ova are deposited irregularly on the stems and leaves, and are cauldron-shaped, dark bronzy-brown, sometimes slightly dusted with a whitish waxy substance (like that on most Hesperid pupæ). There is no special cap. On September 30th, 1907, eleven ova were laid (Pl. V, fig. 1), which hatched on October 6th. The newly-hatched nymphs are shiny reddish-yellow-brown; legs and antennæ semi-transparent, pale yellow-brown, and are very like small red ants (fig. 6). The first moult occurred on October 8th, with very little change, but the nymphs are now larger and darker.

The second moult took place on the 13th, and the nymphs are now very dark, but with little change except in size and colour (figs. 2 and 3).

The third moult was on the 18th, the general hue being dark grey-brown, the tegminal pads quite large, but not noticeable unless examined closely (fig. 4). The adults hatched out on October 23rd (fig. 5).

For some minutes after each moult the entire bug is pinkish or pale red. In each instar the first segment of the tarsi and the antennal articulations are pale. The dorsal odoriferous flaps are very conspicuous in the nymphs.

The last moult is soon accomplished, the adult (as it rids itself of the nymphal skin) being pale yellowish-pink, the wing veins darker pink. The apices of the tegmina are at first slightly crumpled and rather shorter than the apex of the abdomen, but are smooth and flush within fifteen minutes. Within an hour of the ecdysis the natural colouring is complete, chiefly bronzy-brown. The bug apparently sometimes has an extra nymphal instar.

Throughout the nymphal instars the bug is exceedingly like an ant, the later ones closely resembling one of the

commonest Chinese ants, a large black-and-grey species. It is not believed, however, that there is any "protective resemblance" in this association. The nymphs are very active, and stand high on their legs, while the adults spread out the hind-legs very flat, so that the body is near the surface on which the bug rests.

The adults give off a strong smell when irritated. They fly well, and are very common on low herbage and rank vegetation, while from the amount of liquid excrement they pass, they must injure very much the plants on which they feed. They are common throughout the wet season, especially August and September.

Explanation of Plates IV, V.

[*See Explanation facing the* Plates.]

V *Notes on the* Thynnidæ, *with remarks on some aberrant genera of the* Scoliidæ. By Rowland E. Turner.

I have recently dealt with the Thynnidæ of Australia, and now offer some remarks on those of South America, together with descriptions of a few new species and some notes on the Scoliid genera *Iswara* and *Anthobosca*, which are in my opinion most nearly related to *Myzine*. I cannot at present undertake a full revision of the Thynnidæ of South America owing to the want of sufficient material, and also to the impossibility of identifying the majority of Klug's species without a full examination of the types.

The females, except in the genus *Ælurus*, Klug, have the palpi fully developed as to the number of joints, that is, maxillary palpi six- and labial palpi four-jointed, differing markedly in this particular from the bulk of the Australian Thynnidæ. The clypeus in the male is usually emarginate, sometimes very broadly as in typical *Elaphroptera*, sometimes narrowly and deeply as in typical *Scotæna*. The name *Elaphroptera* given by Guérin (1839) has usually been used for the bulk of the South American species, though the name *Scotæna* given by Klug (1810) has priority, and should have been retained if the species were regarded as forming one genus only. Ashmead has recently ("Canadian Entomologist," 1903) attempted a detailed classification, but being based on the differences in the hypopygium it must be considered as almost valueless; such differences, though of importance as specific distinctions, being of little or no value for broader classification, and not usually running on parallel lines with the characters of the females.

In all the males which I have been able to examine the labrum, though varying much in shape, is produced from below near the apex so as to form a more or less transverse trough at the apex; a peculiarity which does not, as far as I know, occur in any Australian species. The mandibles of the males vary much in form, and will probably prove to be one of the most useful characters for classification. They are usually bidentate, sometimes simply curved; but in many cases, as in typical *Elaphroptera*, strongly elbowed. In the genus *Telephoromyia* the

mandibles are tridentate, or, in one or two Peruvian species which I have placed provisionally in that genus, very irregular and broad, with three or more teeth. In the present state of our knowledge any attempt at classification must be of a very provisional nature, and I do not think it advisable to form new genera at present. I apply the name *Scotæna*, Klug, to the species in which the males have the mandibles bidentate, not elbowed, the clypeus narrowly and more or less deeply emarginate, and the hypopygium usually blunt. *Ornepetes*, Guér., and *Spilothynnus*, Ashm., do not seem to differ very much, and I do not see that *Spilothynnus* can be retained as a distinct genus; *Ornepetes* seems to be very near *Scotæna*, but may be retained as a sub-genus at least. The typical species of *Scotæna* have the abdominal segments constricted at the base, which is not the case in *Ornepetes*. *Telephoromyia*, Guér., may be distinguished by the mandibles, which have three or more teeth, the clypeus usually with a small depression at the apex, giving an appearance of emargination, the hypopygium is always unarmed. The females which I class with this genus have the pronotum much longer than broad and not excavated, the prosternum produced anteriorly and forming a neck, the first abdominal segment narrow at the base, the second transversely carinated, and the pygidium truncate. With this genus I would include the two species described by Weyenbergh (Berlin Ent. Zeit., xxvii, 281, 1883) as *Tachypterus argentinus* and *cordoviensis*. The males seem to differ from *Telephoromyia* only in the point of junction of the second recurrent nervure; the female is not available to me, and the description is too poor to be of much use, but shows that it cannot belong to *Diamma*. *Pseudelaphroptera*, Ashm., and *Anodontyra*, Westw., seem to me to be rather closely related to each other, but should certainly be kept as distinct genera until more material is available. In some of the females of the former genus the anterior ocellus is present, though very small. I follow André in considering that *Pycnothynnus*, Ashm., should be sunk in *Elaphroptera*, though that genus may have to be subdivided. *Klugianus*, Ashm., will probably stand as a good genus, but the female is still unknown. The genus *Amblysoma*, Westw., appears to be quite distinct, but I have not seen specimens. *Ælurus*, Klug, forms another group with very distinct females.

Thynnus luzonicus, n. sp.

♂. Antennæ shorter than the thorax. Clypeus very prominent and almost pointed at the base, deflexed to the apex and very broadly truncate. Mandibles blunt at the apex, the tooth on the inner margin very slightly developed. Head closely and rather finely punctured, the interantennal prominence touching the base of the clypeus; the front with a median longitudinal sulca not quite reaching the anterior ocellus. Thorax closely punctured, most finely on the pronotum and on the sides of the mesonotum. Scutellum broadly rounded posteriorly, with a slight subtuberculate prominence on the middle of the apical margin; the postscutellum covering the median segment, which is vertically truncate. Abdomen shining, sparsely but rather deeply punctured; elongate conical, the first segment as broad as the second and vertically truncate anteriorly; the sixth ventral segment with a spine on each side at the apical angles. The dorsal plate of the epipygium is produced from the base, rounded at the apex and longitudinally striated. Hypopygium with a stout spine on each side near the basal angles, thence rather broadly produced and truncate at the apex with a broad apical spine; obliquely striated above.

Black; the clypeus, the mandibles except at the apex, the inner orbits of the eyes, not reaching the summit, a narrow line behind but not touching the eyes, two large spots between the antennæ, a small spot on each side on the vertex, the margins of the pronotum narrowly, a spot on the mesopleuræ below the anterior wings, another above the base of the intermediate coxæ, the tegulæ, a short oblique line behind them, a longitudinal line on each side on the posterior half of the disc of the mesonotum, a broad transverse band on the middle of the scutellum and a spot at each of its basal angles, the postscutellum, the truncation of the median segment and a large spot on the sides, a broadly interrupted transverse band near the middle of the four basal abdominal segments, a spot on each side on the fifth and sixth segments, a spot at the apex of the first ventral segment and one on each side on segments 2–5, the anterior coxæ beneath, the apex of the intermediate and posterior coxæ and the femora beneath yellow. Tibiæ and tarsi ferruginous. Wings hyaline tinged with yellow, nervures black.

Length 21 mm.

Hab. Albay, S.E. Luzon (*Whitehead expedition*).

Type in B. M.

This is a true *Thynnus* of the typical group, and is interesting as extending the range of the genus far beyond the limits hitherto recorded.

Thynnus siccus, n. sp.

♂. Clypeus much produced, broadly truncate at the apex and irregularly longitudinally striated. Labrum narrowed to the apex, projecting much beyond the clypeus. Antennæ as long as the head and thorax combined. Head rather small, narrower than the thorax, closely and finely punctured, the interantennal prominence broadly V-shaped and a short longitudinal carina between the antennæ. Thorax finely and closely punctured; the pronotum very broadly, but slightly, emarginate anteriorly; the scutellum rounded at the apex, the postscutellum covering the median segment which is vertically truncate. Abdomen closely punctured; the three basal segments of about equal breadth, the first vertically truncate anteriorly. A very short spine on each side at the apical angles of the sixth ventral segment. Dorsal plate of the epipygium produced from the base and longitudinally striated. Hypopygium longitudinally striated above, with a spine on each side near the base, thence narrowly produced, subtruncate at the apex, with an acute apical spine.

Light yellow; the antennæ, a broad band on the vertex between the eyes, advanced in the middle and surrounding the ocelli, connected on each side with a longitudinal line reaching the base of the antennæ, a spot on each side of the clypeus below the base of the antennæ, the short frontal carina, a small oblique spot on each side of the pronotum, the sides of the mesonotum and a large semicircular mark on the anterior margin, the mesosternum, the basal and apical margins of the six basal abdominal segments and the whole of the seventh segment black. Wings hyaline, nervures fuscous.

Length 17 mm.

Hab. KILLALPANIMA, east of Lake Eyre, S.A. (*H. J. Hillier*).

Type in B. M.

Telephoromyia peruviana, n. sp.

♂. Mandibles very broad, slightly but very broadly emarginate on the basal half of the outer margin, curved inwards near the apex and terminating in an acute tooth; a tooth on the inner margin at the base of the apical tooth and another above it near the middle of the inner margin, the margin between the two teeth forming a sharp cutting edge; another prominent tooth above, the mandible from the outer margin to the tooth nearly half as broad as the total length, the inner margin sharply angulated at the last tooth, the apical

portion bent downwards. The portion of the margin on which the teeth are situated might perhaps be more correctly described as a very broad apical margin. Clypeus shining, depressed and transverse, deeply depressed on the middle of the apical margin giving the appearance of a narrow emargination with a low tubercle on each side at the base of the emargination. The maxillæ are slender, the galea small with the usual dividing membranous line rather indistinctly marked ; the first joint of the maxillary palpi is very short, the three apical joints rather longer and more slender than the second and third ; the labial palpi are four-jointed, the basal joint much the longest ; the labrum is short and transverse, broadly truncated and ciliated at the apex, expanding from beneath and from the angles into a depressed, subconcave and rounded process, projecting far beyond the true apical margin. Antennæ about as long as the head and thorax without the median segment, nearly as far from each other at the base as from the eyes, the six apical joints arcuate. Head, thorax and sides of the abdomen with thin grey pubescence, cinereous on the front. Head finely and very closely punctured, with an obscure, longitudinal, frontal carina not reaching the base of the clypeus. Pronotum narrower than the head, short and narrowed anteriorly, the anterior margin slightly raised. Mesonotum and median segment closely and finely punctured ; scutellum shining and sparsely punctured, slightly raised above the mesonotum. Median segment rounded, with a faintly-depressed line from the base not reaching the apex ; a short, deeply-impressed, longitudinal sulca on each side at the apex. Abdomen elongate, nearly half as long again as the head and thorax combined, shining and very sparsely punctured ; the first segment with a deep sulca from the base to the middle ; the segments are not constricted at the base. Hypopygium narrow and rather long, rounded at the apex, the sides almost parallel.

Black ; the mandibles, except the margins very narrowly and the apex, the clypeus, a large triangular spot between the eye and the base of the antenna, an oblique spot above the base of each antenna, a small spot on the inner orbit near the summit of the eye, the cheeks with a narrow continuing line broadly interrupted in the middle on the posterior margin of the head, the margins of the pronotum narrowly interrupted in the middle, the anterior margin broadly interrupted on the sides, a spot on the disc of the mesonotum, a curved line above the tegulæ, an irregularly-curved band on the mesopleuræ, a spot before the base of the intermediate coxæ, a large spot on the scutellum and a small spot at the anterior angles, a line on the postscutellum narrowly interrupted on the sides, a broad longitudinal and slightly oblique band on each side of the median

segment, a small spot at the apex of the median segment, a large round spot on each side of the six basal abdominal segments, usually very narrowly emarginate at the base, a spot on each side of ventral segments 2–5, and the coxæ and femora beneath bright yellow; the spines of the tibiæ testaceous. Wings hyaline, nervures black, the stigma ferruginous. The third cubital cell is very much longer than the second, and receives the second recurrent nervure at about one-third of the distance from the base.

Length 13 mm.

♀. Mandibles simple, without teeth. Clypeus broadly emarginate at the apex. Antennæ inserted close to each other, with a small deeply-hollowed space on each side above the base nearly reaching the eyes. Head in front more than half as broad again as long, strongly rounded posteriorly, very closely and finely punctured, with a short, median, frontal sulca. Maxillary palpi six, labial palpi four-jointed, shorter and more slender than in the male. Thorax finely and sparsely punctured; the prothorax subcylindrical, longer than broad, slightly narrowed posteriorly, the anterior margin straight; the prosternum produced anteriorly and forming a neck for the attachment of the head which is widely separated from the pronotum. Median segment obliquely sloped from the mesonotum, the surface flat and almost smooth, with a delicate carina from the base to the apex and the lateral margins slightly raised, broadened from the mesonotum. Abdomen strongly convex, much broader than the thorax, shining and very sparsely punctured; the basal segment narrowed and rather short, the apical margin depressed, most broadly at the sides; second segment with two transverse carinæ, the apical margin also raised, the carina nearest the base curved at the sides; the following segments narrowly depressed on the apical margin. Pygidium truncate posteriorly, the surface of the truncation small and subtriangular, with a tuft of hairs on each side; the hypopygium expanding and rounded at the apex.

Black; the mandibles, antennæ, legs, pygidium and the carinæ on the second abdominal segment ferruginous brown; a large semicircular spot on each side above the base of the antennæ and the anterior and intermediate femora beneath pale yellow; the apex of the second abdominal segment and the sides of all the segments testaceous.

Length 8 mm.

Hab. Urubamba, Peru, 9000–10,000 feet.

It may be necessary to form a new genus for this species and the next, but it is certainly not advisable to do so while the female of typical *Telephoromyia* is unknown.

In some respects the males approach those of *Scotæna*, of which the females are still unknown, but the mandibles and clypeus are very different.

Telephoromyia excisa, n. sp.

♂. Mandibles bidentate at the apex, the exterior tooth long and acute and bent inwards, the interior tooth short and rather blunt, from the base of the teeth the mandibles are much broadened towards the base and produced on the interior margin into a broadly triangular tooth, which when the mandibles are closed fits into the emargination of the clypeus. Clypeus broadly but very shallowly emarginate, smooth and shining, with an obscure tubercle at the base. Head rather small, scarcely broader than the mesonotum, finely and very closely punctured, with a short longitudinal carina above and between the base of the antennæ, with a very delicate impressed line on each side of it touching the base of the antennæ. The antennæ as long as the head, thorax and median segment combined, the six apical joints strongly arched, the second joint of the flagellum shorter than the third. The whole head thinly clothed with long pubescence, black above, grey beneath. Thorax rather more coarsely and sparsely punctured than the head, the pronotum depressed anteriorly, the scutellum long. Median segment very shallowly transversely rugulose, as long as the mesonotum, with a short longitudinal depression on each side at the apex. Abdomen slender and elongate, about one-third longer than the rest of the insect, shining and very sparsely punctured, the first segment long narrowed at the base, with a slight tubercle on each side at one-third from the base, and with a median sulca from the base not reaching the middle. Epipygium strongly punctured at the apex, deflexed and produced, covering the hypopygium and deeply emarginate at the apex. Hypopygium narrow, obtuse at the apex.

Black ; the mandibles except at the apex, the clypeus except the anterior margin, a small spot at the summit of the eyes, the margins of the eyes below the base of the antennæ, a triangular spot on the scutellum, a transverse spot on the postscutellum, a large irregular spot occupying the sides of abdominal segments 1–6, enclosing a small black spot on segments 2–5, a spot on each side of ventral segments 2–5, a line beneath the intermediate and posterior femora, and the anterior tibiæ except at the apex yellow ; the intermediate and posterior tibiæ and tarsi fusco-ferruginous, the anterior tarsi fusco-ferruginous at the base, the three apical joints fuscous. Wings hyaline, faintly iridescent, nervures black, the stigma ferruginous.

The branch nervure dividing the first cubital cell is only indicated by a scar.

The three apical joints of the maxillary palpi are longer and slenderer than the others.

Length 17 mm., exp. of wings 31 mm.

Hab. PERU.

Type in Oxford University Museum.

Allied to the last species, but differs in the form of the mandibles and clypeus, as well as in colour and size.

Telephoromyia bituberculata, n. sp.

♀. Mandibles simple, rather short; labrum prominent; maxillary palpi short, six-jointed; labial palpi short, four-jointed. Clypeus truncate at the apex. Head about half as broad again as long, rounded at the posterior angles, twice as broad as the pronotum, finely and closely punctured, with a short, median, longitudinal sulca on the front. Pronotum narrow, longer than broad, the sides almost parallel, strongly convex; the prosternum narrowly produced anteriorly, forming a neck; the anterior angles of the pronotum slightly produced. Mesonotum very small and narrowed posteriorly; the median segment depressed, subtriangular, narrowly truncate at the base, the dorsal surface flat. Thorax and abdomen shining and sparsely punctured, most strongly on the abdomen. First abdominal segment compressed at the sides and strongly elevated to the middle which is subcarinate longitudinally, strongly produced anteriorly on the dorsal surface and overlapping the median segment for nearly half its length, pointed at the extremity and produced into a short bifurcate process. Second segment much broader than the first, with two strong transverse carinæ, curving forward at the sides, the space between the second carina and the apex almost smooth, the apical margin slightly raised. All the segments, except the second, narrowly depressed on the apical margin. Pygidium small, the epipygium ovate, finely rugose, surrounded by a dense fringe of rather short fulvous pubescence, almost vertically truncate, hypopygium produced, abruptly widened close to the apex and truncate. The ventral segments more strongly punctured, segments 2–4 with a large broadly triangular depressed surface in the middle of the apical margin. Intermediate coxæ widely separated, the intermediate and posterior tibiæ hollowed externally near the apex and strongly pubescent. Tarsal ungues bifid.

Black; a large spot on each side on the front round the base of the antennæ, produced at the sides into a narrow line extending to

the vertex, the sides of the head and the anterior margin of the clypeus pale lutaceous yellow; the mandibles, antennæ, the carinæ on the second abdominal segment, the pygidium, the tibiæ obscurely and the tarsi dull ferruginous brown; the apical margins of the abdominal segments above and beneath testaceous.

Length 8 mm. ♂ unknown.

Hab. MENDOZA, Argentina. (Purchased from *H. Rolle.*)

Distinguished from all other species known at present by the form of the first abdominal segment.

Scotæna turbulenta, n. sp.

♂. Mandibles not elbowed, bidentate, the outer tooth rather long and broad, the inner tooth very short and blunt. Clypeus deeply and rather broadly triangularly emarginate, the apical angles produced. Antennæ a little longer than the head, thorax and median segment combined, the seven apical joints arcuate, inserted about as far from each other as from the eyes. Head strongly punctured, no broader than the mesonotum. Thorax rather sparsely punctured; the pronotum short with the anterior margin raised; the scutellum broadly rounded at the apex, with a depressed transverse row of large punctures at the base. Median segment shining, very shallowly punctured, a little longer than the mesonotum. Abdomen elongate and slender, shining and sparsely punctured; segments 2–5 constricted at the base and very narrowly depressed on the apical margin; the basal segment very slender at the base with a minute tubercle on each side near the middle and a deep median sulca from the base reaching beyond the middle. Epipygium very deeply punctured and narrowly rounded at the apex; hypopygium narrow and short, not projecting beyond the epipygium and truncate at the apex. The claspers are rather long and pointed.

Black; the mandibles except at the apex, the clypeus, a spot above the base of each antenna, the margins of the eyes as high as the base of the antennæ, and a narrow line on the inner margin of the eyes near the summit, a transverse line on each side on the posterior margin of the head, the posterior margin of the pronotum, a spot on each side of the prothorax, a small round spot on the mesonotum, a curved line above the tegulæ, a curved spot below the base of the anterior wings and two smaller spots below it, a spot on the scutellum and one on each side at its basal angles, the postscutellum, a spot on the sides of the median segment at the base, two longitudinal marks on the median segment sharply curving outwards towards the apex, a narrow transverse band near the apex of the first abdominal

segment, a transverse spot on each side of segments 2–4 above and below and a small spot on each side of the fifth segment, the coxæ beneath and a line beneath the femora yellow. Wings hyaline, very slightly tinted with yellow, iridescent, with a faint fuscous cloud in the radial cell, nervures black, stigma and costa ferruginous.

Length 17 mm., exp. 29 mm.

Hab. CARACAS, Venezuela. Type in Oxford University Museum.

Pseudelaphroptera rollei, n. sp.

♂. Clypeus moderately produced, narrowed to the apex, where it is very feebly emarginate and produced into a minute tooth at each of the apical angles; a depressed longitudinal sulca from the base almost reaching the apex. Antennæ inserted far apart, nearly half as far again from each other as from the eyes, as long as the head and thorax, not including the median segment, the second joint of the flagellum a little shorter than the third. Head closely punctured, with thin grey pubescence on the clypeus and the front, a very delicate longitudinal carina between the antennæ continued very faintly to the anterior ocellus. Mandibles bidentate at the apex, not elbowed, the outer tooth longer than the inner. Pronotum almost as broad as the head, slightly and broadly emarginate anteriorly, the anterior margin feebly raised. Thorax punctured, closely on the sides of the mesonotum and between the two longitudinal lateral sulcæ, elsewhere sparsely. Median segment broad, a little shorter than the mesothorax, finely and rather irregularly transversely striated. Abdomen as long as the head, thorax and median segment combined, nearly as broad as the thorax and tapering very slightly at the extremities, deeply and rather sparsely punctured. Hypopygium rather broad, produced slightly beyond the epipygium, subtruncate at the apex with a strong, acute apical spine.

Black; the base of the mandibles, the clypeus, the pronotum except a black triangular mark on each side, a large spot on the mesonotum, the tegulæ, a large irregular spot on the mesopleuræ, a large spot on the scutellum and a spot on each side at its basal angles, a transverse line on the postscutellum with a spot on each side, two oblique bands on the median segment diverging from the base, a broad band on each of the dorsal segments of the abdomen interrupted in the middle, except the seventh segment, which is wholly black, a small spot on each side of the first ventral segment and an interrupted band on segments 2–5, the anterior and posterior coxæ beneath and a line on the anterior and intermediate femor;

beneath pale yellow; legs ferruginous. Wings hyaline, nervures ferruginous. The second recurrent nervure is interstitial with the second transverse cubital nervure.

Length 15 mm.

Hab. MENDOZA, Argentina. (Purchased from *H. Rolle.*)

In colour and size this species resembles *Telephoromyia rufipes*, Guér., which occurs in the same locality. It is not very near typical *Pseudelaphroptera*, and I place it in the genus with doubt.

Pseudelaphroptera flavomaculata, André.

Zeitsch. Hym. Dipt., vi, p. 311, 1904.

A male of this species in the Oxford University Museum has the third transverse cubital nervure very short and connected with the summit of an arched nervure which originates on the cubital nervure at the junction of the second recurrent nervure, and rejoins the cubital nervure far beyond the usual termination of the third cubital cell. The extra cell thus formed is slightly longer on the cubital nervure on the left wing than on the right. There is another normal specimen in the same collection; both specimens being from Concepcion.

The females of some species of this genus have the anterior ocellus present, though small and situated at the bottom of a deep puncture; this is the case in *P. chilensis*, Sauss. In *Diamma*, Westw., the female has all three ocelli developed, but in other Thynnidæ they are always absent.

Elaphroptera avida, n. sp.

♂. Mandibles bidentate, broadened towards the apex, the inner tooth short, the outer one long and bent inwards. Maxillary palpi six-jointed, the first joint very short, joints 3–5 broadened to the apex and obliquely truncate. Labial palpi stout, four-jointed, the first joint a little longer than the others, the apical joint elongate ovate. Labrum short and broad, with a high transverse carina broadly and deeply emarginate and strongly ciliated at the sides, the area in front of the carina to the apex depressed, membranous and broadly emarginate at the apex. Clypeus punctured, with a large, smooth, semicircular depression in the middle, broadly emarginate at the apex with the angles pointed. Antennæ as long as the thorax

and median segment combined, inserted rather far apart, as far from each other as from the eyes, the five apical joints slightly arcuate; the interantennal prominence transverse at the apex, with a very slight tubercle in the middle; an obscure carina from the anterior ocellus reaching almost to the base of the clypeus. Head closely and rather finely punctured, the eyes diverging towards the clypeus; vertex broad, the posterior ocelli twice as far from the eyes as from each other. Thorax and median segment closely punctured; pronotum short, narrower than the head, the anterior margin slightly raised; the mesonotum about one-third broader than long, with the usual two longitudinal sulcæ on each side; the scutellum moderately elevated; the median segment rounded, as long as the breadth at the base, with a longitudinal sulca on each side at the apex. Abdomen slender, half as long again as the head, thorax and median segment combined, closely and shallowly punctured, some of the punctures confluent; the first segment slender at the base, with a short longitudinal sulca not quite reaching the centre, segments 2–5 with a feebly depressed transverse line close to the base; the epipygium narrowed towards the apex and subtruncate. Hypopygium narrow, with almost parallel sides, projecting a little beyond the epipygium and rounded at the apex.

Black; the mandibles except at the apex, the clypeus, the cheeks, the inner orbit of the eyes not reaching the summit, a small spot above the base of each antenna, the anterior margin of the pronotum and an arched line behind it touching the anterior margin in the middle, a large spot in the middle of the scutellum and a small one at each at its basal angles, the postscutellum, a round spot on each side near the apex of the median segment, a spot on each side of each abdominal segment, occupying almost the whole length of the segment but hardly extending onto the dorsal surface and a narrow line on the femora beneath yellow; the seventh segment ferruginous at the apex. Wings flavo-hyaline, nervures ferruginous.

Length 20 mm.

Hab. TUCUMAN, N.W. Argentina (*H. Schulz*).

Nearly allied to *Thynnus lateralis*, Klug, but the shape of the median segment is very different and the whole insect is of slenderer build.

Elaphroptera ichneumonea, Klug.

Thynnus ichneumoneus, Klug, Physik. Abh. Akad. Wiss. Berlin, p. 25, n. 22, 1840 (1842), ♂.

Thynnus elegans, Sm., Cat. Hym. B. M., vii, p. 51, n. 176, 1859, ♂.

Elaphroptera maculipennis, Guér.

Elaphroptera maculipennis, Guér., Voy. Coq. Zool., ii, 2, p. 243, 1830 (1839), ♂.
Thynnus mystacinus, Klug, Physik. Abh. Akad. Wiss. Berlin, p. 27, n. 28, 1840 (1842), ♂.
Thynnus ornatus, Klug, l. c., p. 29, n. 31, ♀.
Thynnus plagiatus, Sm., Cat. Hym. B. M., vii, p. 52, n. 178, 1859, ♂.

There are two pairs from Parana in the British Museum collection. The female agrees well with Klug's description of *ornatus*, the males are without the yellow spot on the mesonotum which is present in the type of Smith's species.

The three species last named are allied to *lateralis*, Klug, *E. ichneumonea* and *E. avida* most closely so. They will probably form a new genus when more material is available, in view of the short, broadly emarginate clypeus of the male, produced into a spine at the angles; and the straight, short and narrow hypopygium. The females of the group seem to be distinguished by a more or less excavated pronotum and a rather narrow pygidium.

Elaphroptera herbstii, André.

Elaphroptera herbstii, André, Zeitsch. Hym. Dipt., 6, p. 308, n. 5, 1904, ♂.

♀. Head very little more than half as long as broad, the posterior angles slightly rounded; eyes small and oval, divided by a little less than their own length from the base of the mandibles. Head, thorax and median segment sparsely punctured; pronotum half as broad again as long, the sides parallel, the anterior margin straight, deeply and broadly depressed in the middle. Median segment sparsely punctured at the base, where it is only half as wide as the pronotum, short, obliquely truncate posteriorly and broadened to two-thirds of the width of the pronotum, the surface of the truncation almost smooth and slightly concave, with a strong median carina on the apical half. Abdomen longer than the head and thorax, convex above, flattened beneath, finely and shallowly punctured, broadest at the third segment, which is nearly twice as wide as the pronotum; the apical margin of the basal segment feebly depressed; the second segment transversely rugose, the apical margin raised, smooth at the

base with a low transverse carina before the rugose area ; third and fourth segments with an impressed transverse line near the base, the extreme base smooth. Pygidium twice as long as broad, obliquely depressed, longitudinally rugose and a little widened to the apex. The posterior femora flattened above and curved at the apex.

Opaque black, the head shining ; two large quadrate spots narrowly separated from each other on the front round the base of the antennæ ochreous ; the flagellum and the pygidium at the apex fuscous.

Length 10 mm.

In the British Museum.

Elaphroptera intaminata, Sm.

Thynnus intaminatus, Sm., Descr. n. sp. Hym., p. 173, n. 41, 1879, ♂.

Thynnus (*Elaphroptera*) *holomelas*, André, Voy. Belgica. Zool. Hym., p. 61, pl. ii, fig. 8, ♂.

Elaphroptera erythrura, Spin.

Thynnus erythrurus, Spin., Gay Hist. Fis. Chile Zool., vi, p. 295, 1851, ♂.

Elaphroptera relicta, Sauss., Reise d. Nov. Zool., ii, 1, Hym., p. 126, 1867, ♀.

There is a pair of this species in the British Museum, showing that Saussure was right in his suggestion that they are the sexes of one species.

Elaphroptera arcuata, n. sp.

♂. Clypeus closely and rather coarsely punctured, strongly convex at the base, with a prominent median carina, very strongly and broadly emarginate at the apex. Antennæ as long as the thorax and median segment combined, as far from each other at the base as from the eyes, the seven apical joints are arcuate. Head finely and closely punctured, with a delicate carina from a little below the anterior ocellus reaching almost to the base of the clypeus ; the posterior ocelli half as far again from the eyes as from each other ; the front and cheeks clothed with long, sparse, cinereous pubescence. Mandibles sharply bent just before the middle, with a slight tubercle at the bend, bidentate at the apex, the inner tooth very short. Pronotum short, rounded at the sides, the anterior margin straight and raised. Thorax and median segment closely and rather finely

punctured, very shallowly on the median segment; the usual two longitudinal sulcæ on each side of the mesonotum; the scutellum subtriangular, rather narrowly truncate at the apex. Median segment rather slender, depressed and narrowed to the apex. The sides of the thorax and median segment with long, sparse, cinereous pubescence. Abdomen shining, almost entirely smooth, slender, a little longer than the head, thorax and median segment combined; the first segment very narrow at the base, about half as wide at the apex as long, the apical margin rather widely depressed. Epipygium long, sparsely punctured, rounded at the apex; hypopygium not projecting beyond the epipygium, trilobed, the central lobe the longest. The second recurrent nervure is received a little before the middle of the third cubital cell.

Entirely black. Wings hyaline, faintly iridescent, nervures fuscous. Length 11 mm., exp. 19 mm.

Hab. Lago Xanco, Chubut.

Type in B. M.

Nearly allied to *E. herbstii*, André, from Chili, but is without a tubercle at the base of the clypeus, and the median segment and first abdominal segment are much slenderer in the present species.

Elaphroptera inca, n. sp.

♂. Mandibles long, bent inwards near the apex, bidentate, the outer tooth very long, the inner one short. Maxillary palpi six-jointed, the first joint very short, the third broad and rather short, the second, fifth and sixth of almost equal length, about half as long again as the third, the fourth joint the longest. Labial palpi four-jointed, the second and third joints short and stout, together about as long as the first. Labrum very long and slender, petiolate, expanding abruptly at the apex in a semicircle, truncate at the extreme apex and fringed with long hairs, produced from beneath near the apex, the lower portion truncate and extending as far as the true apex, forming with it a narrow transverse trough. Clypeus sparsely punctured, rather narrow, very much produced and subtruncate at the apex, with a shallow depression on each side below the centre, and a smooth, shallow, semicircular depression just above the centre. Antennæ as long as the head, thorax and median segment combined, the six or seven apical joints feebly arcuate. Head rather small, a little narrowed behind the eyes, finely and closely punctured; the interantennal prominence transverse at the apex, divided by a deep sulca; a little sparse and rather long black

pubescence on the front. The posterior ocelli twice as far from the eyes as from each other. Thorax closely and finely punctured, more sparsely on the disc of the mesonotum and on the scutellum; pronotum much narrowed in front, the anterior margin slightly raised; mesonotum with the usual two longitudinal sulcæ on each side, as long as broad; scutellum rounded at the apex, raised in the centre; median segment as long as the mesonotum, very shallowly punctured, with a deep longitudinal depression on each side near the apex. Abdomen slender, about one-third longer than the head, thorax and median segment combined, very sparsely punctured; the first segment slender at the base, with a deep longitudinal sulca not quite reaching the apex; the segments very slightly depressed on the apical margin, with a fringe of very short sparse pubescence; segments 3 and 4 with a tuft of long fulvous pubescence at the apical ventral angles; segments 2–5 with an impressed transverse line close to the base; the epipygium broadly truncate at the apex. Hypopygium narrow, projecting beyond the epipygium, slightly broadened and strongly rounded at the apex. The first joint of the tarsi is only about one-quarter shorter than the tibiæ.

Shining black; the mandibles except the extreme apex, the clypeus, the orbits of the eyes narrowed continued almost to the posterior margin of the head, a square spot above the base of each antenna, the pronotum very narrowly interrupted in the middle and with a very large black mark on each side, a short longitudinal line on each side near the anterior margin of the mesonotum along the inner sulca, a narrow line above the tegulæ, the tegulæ, a large irregular mark covering the greater part of the mesopleuræ, a small spot near the posterior margin of the mesonotum, a spot on the centre of the scutellum and one on each side at the basal angles, the postscutellum except a large black spot on each side, a longitudinal band on each side not far from the middle of the median segment, curving downwards at the apex and uniting with another longitudinal band on the side of the segment, the sides of the first abdominal segment, almost uniting near the apex, a very large spot on each side of segments 2–5, more or less broadly separated on the middle of the segment, the sixth segment, the epipygium except a spot at the apex, the middle of the first ventral segment, the apical half of segments 2–5, the sixth segment with a black spot on the middle, the prosternum and the legs golden yellow; the hypopygium ferruginous, fuscous at the apex. Wings flavo-hyaline, nervures fusco-ferruginous.

Length 23 mm., exp. 40 mm.

Hab. Yungas de La Paz, Bolivia, 3000 ft.

This species is only placed in *Elaphroptera* provisionally.

Anodontyra tricolor, Westw.

Anodontyra tricolor, Westw., Proc. Zool. Soc. London, iii, p. 71, 1835, ♂.
" " André, Zeitsch. Hym. Dipt., vi, p. 317, 1904, ♂, ♀.
Thynnus albofasciatus, Sm., Descr. n. sp. Hym., p. 173, 1879, ♂.

Albofasciatus, Sm., is certainly a synonym of *tricolor*, Westw. If the species noticed by André under the name of *albofasciatus* proves to be distinct it will have to receive a new name. The position of the ocelli in the female of *A. tricolor* is marked by shallow punctures.

Cophothynnus, n. gen.

Ælurus, Klug, Physik. Abh. Akad. Wiss. Berlin, p. 42, 1840 (1842).

The name *Ælurus* being preoccupied in Mammalia I suggest the above name in its place.

C. nasutus, Klug.

Ælurus nasutus, Klug, Physik. Abh. Akad. Wiss. Berlin, p. 43, 1840 (1842), ♂, ♀.
Thynnus picinus, Westw., Trans. Ent. Soc. London, p. 133, 1881, ♀.

A female specimen in the British Museum from Petropolis, Brazil.

C. gayi, Spin.

Ælurus gayi, Spin., Gay, Hist. Chile Zool., vi, p. 305, 1851, ♂.
Thynnus macilentus, Sm., Descr. n. sp. Hym., p. 172, n. 40, 1879, ♂.
Var. *Thynnus nigrofasciatus*, Sm., l. c., n. 38, ♂.
Nigrofasciatus, Sm., seems to be merely a colour variety.

This species approaches the Australian sub-genus *Lepteirone*, but has the hypopygium narrow and slightly produced and the second cubital cell less strongly narrowed on the radial nervure.

Cophothynnus iridipennis, Sm.

Myzine iridipennis, Sm., Descr. n. sp. Hym., p. 181, n. 11, 1879, ♂.

♂. Clypeus scarcely produced, slightly emarginate at the apex. Mandibles bidentate, the outer tooth long and acute. Antennæ a little shorter than the head and thorax, the third joint of the flagellum nearly half as long again as the second. Head narrowed behind the eyes, finely and shallowly punctured, a laminate prominence above the base of each antennæ, the front and cheeks with sparse white pubescence. Eyes very slightly convergent towards the vertex, the inner margin almost straight; the posterior ocelli about twice as far from the eyes as from each other, nearer to the eyes than to the posterior margin of the head. Thorax rather sparsely punctured; the scutellum triangular. Median segment rounded, longer than broad, longer than the mesonotum, closely and shallowly punctured. Abdomen as long as the rest of the insect, fusiform, very closely punctured; with a raised curved mark on each side of segments 2–4, just before the narrowly-depressed apical margin. Hypopygium rounded at the apex and ciliate, projecting a little beyond the epipygium. The first cubital cell is divided, much shorter than the second on the cubital nervure, the third is rhomboidal, also shorter than the second.

The abdomen is less elongate than in most species of the genus and the whole insect is more stoutly built. The three apical joints of the maxillary palpi are very long and slender, combined half as long again as the head. Otherwise as in Smith's description.

Hab. Egga (*Bates*).

Fox (Proc. Acad. Philad., 50, p. 72, 1898) places *Elaphroptera carbonaria*, Sm., and *Thynnus æthiops*, Klug, in the genus *Ælurus*. He may prove to be correct, the three apical joints of the maxillary palpi being very long and slender, especially in *carbonaria*, but they are not very near any known species of *Ælurus*, and the female is unknown. *Thynnus anthracinus*, Klug, is closely allied to *æthiops*.

Eirone mutabilis, n. sp.

♂. Clypeus slightly advanced, with a vertical triangular truncation at the apex. Head shining, shallowly punctured, the front almost vertical and broad; the antennæ slender, about half as long again as the head, with a short and obscure V-shaped carina between them; the vertex long and broad, the posterior ocelli nearly twice as

far from the margin of the head as from each other. Pronotum narrower than the head, more than half as long as the mesonotum, the anterior margin straight and very strongly raised. Thorax punctured; the scutellum subtriangular, narrowly truncate at the apex. Median segment scarcely more than half the length of the mesonotum, nearly twice as broad as long, obliquely truncate posteriorly, punctured, with a small depression at the base. Abdomen shining, almost smooth, subcylindrical; the second and third segments transversely depressed at the base; the apical segment large, the hypopygium rounded and ciliate at the apex, not projecting beyond the epipygium; the first ventral segment subtuberculate near the base, shallowly divided from the second segment.

Black; the antennæ fusco-ferruginous; the mandibles, clypeus, the anterior margin of the pronotum broadly, a large round spot on the scutellum, the femora, tibiæ and tarsi light yellow.

Length 8–9 mm.

Hab. ADELAIDE RIVER, Northern Territory, S. Australia. Type in B. M.

Allied to *E. scutellata*, Turn., but differs in the shape of the head, clypeus, median segment and abdomen.

Family SCOLIIDÆ.

Genus *Iswara*, Westw.

Iswara, Westw., Trans. Ent. Soc. London (2), i, 7, p. 232, 1851.
Komarowia, Radosz., Horæ Soc. Ent. Ross., xx, p. 41, 1886.
Meria, section *Komarovia*, Sauss., Grandid. Hist. Madag., xx, p. 249, 1892.

The males of this genus are closely allied to those of *Myzine* proper, from which the genus is almost undoubtedly derived by adaptation to nocturnal habits and desert conditions. Saussure does not consider that the genus can be separated from *Myzine* (*Meria*), but the male of *Myzine tripunctata*, Ross, has the palpi normal, whereas in *Iswara* the maxillary palpi have only three joints in place of six, and the labial palpi three joints instead of four. The antennæ are also very much longer and more slender, and the neuration does not extend to the margin of the wing. The latter point, however, is not of very much importance, as *Myzine* (*Meria*) *timurella*, Sauss., also shows this peculi-

arity, as well as much-enlarged ocelli, though these are not quite as much developed as in typical *Iswara*. It is quite possible, however, that when both sexes are known in this genus and in the allied *Meria* in a larger number of species than is at present the case, Saussure's opinion may prove to be correct, as in this group differences between the females do not invariably correspond closely to those between the males. As I have not been able to obtain specimens for dissection of the mouth parts I cannot give any accurate list of the males that should be assigned to the genus. Saussure places two females in *Komarovia*.

1. *I. tartara*, Sauss., Fedtsch. Turkestan, ii, Scol., p. 38, 1880, ♂, *Meria t.*
   Komarowia victoriosa, Radosz., Hor. Soc. Ent. Ross., xx, p. 44, 1886, ♀; l. c., xxiii, p. 309, 1889, ♂, ♀.
2. *I. tamerlanella*, Sauss., Fedtsch. Turkestan, ii, Scol., p. 41, 1880, ♀, *Pseudomeria t.* (*Pscud. tartara* on plate.)
   Myzine pseudotartara, D. T., Cat. Hym., viii, p. 126, 1897.

I. lutcus, Westw., is very nearly allied to *I. tartara*, but has the third cubital cell larger than the second, whereas in *I. tartara* the second is larger than the third. *I. fasciatus*, Sm., *Myzine orientalis*, Sm., *Meria radialis*, Sauss., *Myzine pallida*, Sm., and perhaps *Meria nocturna*, Mor., will probably prove to belong to the genus.

Though all authors seem to have followed Westwood in placing *Iswara* amongst the Thynnidæ, I fail to see any cause for removing it from close connection with *Myzine*, and it is quite evident that Saussure would at once have perceived the connection had he been acquainted with Westwood's species.

Genus *Pterombrus*, Sm.

Pterombrus, Sm., Trans. Ent. Soc. London, p. 302, Pl. 6, 1869.
Engycystis, Fox, Proc. Californ. Acad. Sc. (2), v, p. 262, 1895.

To this genus belong—

1. *P. ænigmaticus*, Sm., Trans. Ent. Soc. London, p. 303, Pl. 6, fig. 1, 1869, ♀, Brazil.

2. *P. confusus*, Sm., Descr. n. sp. Hym., p. 182, n. 12, 1879, ♂ (*Myzine c.*), Ega, Brazil.
3. *P. rufiventris*, Cress., Trans. Amer. Ent. Soc., iv, p. 201, 1872, ♂ (*Myzine r.*).
   " " Fox, Proc. Californ. Acad. Sc. (2), v, p. 263, 1895, ♂, ♀ (*Engycystis r.*), Mexico and Texas.

Fox gives a good description of the genus, but has not connected it with *Pterombrus*. He remarks on the many points in which it differs from *Myzine*. The first two species may prove to be the sexes of one species. The posterior coxæ of the female are contiguous.

Though very distinct I look on the genus as more nearly allied to *Plesia* than to any other Scoliidæ.

Genus *Anthobosca*, Guér.

The following species belong to this genus in addition to the Australian species which I have enumerated in a former paper (Proc. Linn. Soc. N.S.W., xxxii, 3, 1907).

Species from S. America.

1. *A. albomaculata*, Sm., Descr. n. sp. Hym., p. 181, n. 10, 1879, ♂, ♀ (*Myzine a.*), Ega.
2. *A. bipunctata*, Perty, Delect. Anim. Artic. Brasil., p. 139, 1830, ♀ (*Tiphia b.*), Minas Geraes.
3. *A. antennata*, Sm., Descr. n. sp. Hym., p. 174, n. 2, 1879, ♂ (*Anthobosca a.*), Rio Grande do Sul.
   Cosila iheringi, Sauss., Grandid. Hist. Madag., xx, p. 234, 1892, ♀.
4. *A. carbonaria*, Burm., Stett. Ent. Zeit., xxxvii, p. 168, 1876, ♀ (*Myzine c.*), Neu Freiburg.
5. *A. erythropyga*, Burm., Stett. Ent. Zeit., xxxvii, p. 169, 1876, ♂, ♀ (*Myzine e.*), Cordova.
6. *A. apicalis*, Sich., Sauss. et Sich. sp. gen. Scol., p. 262, 1864, ♀, S. America (?) (*Cosila a.*).
7. *A. chilensis*, Guér., Voy. de la Coq. Zool., ii, 2, p. 249, 1830 (1839), ♀ (*Scolia* (*Cosila*) *c.*), Chili.
   " " Spin., Gay, Hist. Fis. Chile Zool., vi, p. 312, 1851, ♂, ♀.
   Myzine flavicornis, Sm., Descr. n. sp. Hym., p. 183, n. 16, 1879, ♀.

Species from Africa and Madagascar.

8. *A. insularis,* Sm., Descr. n. sp. Hym., p. 178, n. 4, 1879, ♀ (*Myzine i.*), Madagascar.
   Cosila insularis, Sauss., Grandid. Hist. Madag., xx, p. 231, 1892, ♀.
9. *A. donaldsoni,* Fox, Proc. Acad. Philad., p. 549, 1896, ♀ (*Cosila d.*), Somaliland.
10. *A. errans,* Sm., Descr. n. sp. Hymen., p. 174, n. 1, 1879, ♂ (*Anthobosca e.*), Zululand.

Anthobosca antennata, Sm.

A. antennata, Sm., Descr. n. sp. Hym., p. 174, n. 2, 1879, ♂.
Cosila iheringi, Sauss., Grandid. Hist. Madag., xx, Pt. 2, p. 234, 1892, ♀.

♀. Clypeus small, triangular and almost smooth. Head shining, sparsely punctured, the antennæ gradually thickened from the base of the flagellum, the joints except the second much broader than long; eyes very feebly emarginate on the inner margin, the ocelli placed well forward, the anterior ocellus nearly as far from the posterior margin of the head as from the base of the clypeus. Pronotum as broad as the head, as long as the mesonotum, the anterior margin depressed and broadly emarginate, finely and closely punctured with a row of larger punctures on the anterior and posterior margins. Mesonotum short, sparsely punctured; scutellum rather large, broadly rounded at the apex; median segment short and broad, truncate posteriorly and slightly broadened from the base, very closely and minutely punctured. Abdomen much longer than the head, thorax and median segment combined, broader than the thorax; finely punctured, more closely at the base of the segments than at the apex, shining; the pygidium rounded at the apex, the epipygium thickly clothed with coarse fulvous pubescence. As in other species of the genus, the intermediate coxæ are widely, the posterior rather less widely, but very distinctly, separated. The radial cell is rounded at the extreme apex. Tarsal ungues bifid.

Black; the mandibles and antennæ fusco-ferruginous; an interrupted transverse band close to the posterior margin of the pronotum, a transverse spot on the posterior margin of the mesonotum, a small spot at the base of the median segment, a spot on the sides of the prothorax close to the anterior angles, a spot on the mesopleuræ at

the base of the anterior wings, an interrupted band on the first dorsal segment of the abdomen and a transverse band on each side of the second, third and fourth segments, most widely divided on the second, yellow; femora, tibiæ and tarsi ferruginous; tegulæ testaceous. Wings hyaline, faintly tinged with yellow, nervures ferruginous. Length 14–15 mm.

Hab. Rio Grande do Sul.

As in other species of the genus the division between the first and second ventral segment is very much less deeply marked than in *Myzine*, and the posterior coxæ separated.

The male sent with this species differs from the type of *antennata* by the slightly longer pronotum, the rather stronger punctures on the head and the very slightly longer antennæ. I do not think these differences sufficient to merit specific rank.

Anthobosca natalica, n. sp.

♀. Clypeus flat and subtriangular, the apical margin depressed. Head shining, sparsely punctured, very finely on the vertex, more coarsely on the front. Antennæ inserted as far from each other as from the eyes, the front depressed round their base. Eyes rather small, almost touching the base of the mandibles, but not reaching quite as high as the posterior ocelli. Thorax sparsely punctured, shining; the pronotum as broad as the head, slightly but broadly emarginate anteriorly, very large, nearly twice as long as the mesonotum, extending backwards to the tegulæ, the posterior margin almost straight; the scutellum broadly rounded posteriorly. Median segment rather short, minutely punctured. Abdomen broader than the thorax and longer than the head, thorax and median segment combined, very finely punctured, with a row of large setigerous punctures just before the depressed apical margin of each segment, the pygidium clothed with coarse fulvous pubescence. The tarsal ungues are bidentate, but not so strongly as in most extra-Australian species of the genus, and the anterior tarsi are pectinate. The radial cell is rounded at the apex; the first recurrent nervure is received just beyond the middle of the second cubital cell, the second just before the middle of the third cubital cell.

Black; the pubescence grey, except on the pygidium; the tarsi and spines of the anterior tibiæ fusco-ferruginous, the spines of the intermediate and posterior tibiæ whitish; the tegulæ and the sides and apical margins of the abdominal segments testaceous brown.

Wings pale fusco-hyaline, nervures fusco-ferruginous, the stigma black. Antennæ missing.

Length 12 mm.

Hab. MALVERN, Natal (*J. P. Cregoe*).

Type in B. M.

It may be necessary in the future to separate the Australian species of *Anthobosca* from the others in consideration of the difference in the tarsal ungues and the anterior tarsi of the female. In this case the name *Anthobosca* must be retained for the Australian species, and *Cosila* used for the others. But as there are differences of degree in these points, and only one or two species of the genus have been paired so far, it is better to keep them together for the present. In *A. clypeatus*, Sm., the tarsal ungues are bifid.

Anthobosca lagardei, n. sp.

♂. Antennæ as long as the thorax without the median segment, stout, the joints as broad as long. Eyes very broadly and slightly emarginate on the inner margin. Head minutely and very closely punctured, rounded; the posterior ocelli half as far again from the eyes as from each other. Thorax and median segment very finely and closely punctured, the pronotum narrowed and slightly depressed anteriorly, the mesonotum with two longitudinal sulcæ on each side, the outer one narrow and shallow, the inner one deep; the scutellum subtriangular, truncate at the apex; the median segment of about the same length as the mesonotum. Abdomen as long as the head, thorax and median segment combined, of nearly equal breadth throughout, the first segment narrowed to the base, opaque; the hypopygium rounded at the apex and unarmed.

Black; the posterior margin of the pronotum, a small transverse spot on the posterior margin of the mesonotum, the tegulæ, a spot on the postscutellum, a spot at the apex of the median segment, a large spot on each side of the epipygium, the extreme apex of the anterior and intermediate femora, the anterior tibiæ, the base of the intermediate and posterior tibiæ, the first joint of all the tarsi; the second joint of the anterior and intermediate tarsi, and the three apical joints of the maxillary palpi dull testaceous yellow.

Length 8 mm.

Hab. SYDNEY, N.S.W. (*De la Garde*), January.

Type in B. M.

In my recent revision of the Australian species of *Anthobosca* (Proc. Linn. Soc. N.S.W., 1907) I gave *Cosila* (*Colobosila*) *fasciculata*, Sich., as a synonym of *A. anthracina*, Sm. This is almost certainly a mistake, as the radial cell of *anthracina*, although obtuse at the apex, cannot be said to be truncate.

Cockerell (Bull. Mus. Comp. Zool. Harvard, 1906) has described a new genus *Austrotiphia* for *A. kirbyi*. I have not seen his paper, but the type of his species is in the British Museum, and is certainly identical with *Anthobosca anthracina*, Sm. This species does not seem to differ appreciably in structure from the typical species of *Dimorphoptera*, Sm., except in the radial cell, which is obtuse at the apex.

The genus *Odontothynnus*, Cam. (Rec. Albany Mus., i, 3, p. 161, 1904), containing two species from Grahamstown, Cape Colony, is very closely allied to *Anthobosca* as far as I can judge from the description, and should be placed in the Scoliidæ rather than in the Thynnidæ. His assumption that the females are apterous will probably prove to be erroneous.

In the same publication (i, 5, p. 306, 1905) he refers again to his genus, and suggests that *Anthobosca antennata*, Sm., may belong to it. This is evidently a slip of the pen for *A. errans*, Sm., but in that species the apex of the clypeus is not bidentate, nor are the posterior tarsal ungues simple. These distinctions, unless accompanied by differences in the female, are hardly in my opinion of generic value, and it is hardly advisable in this family to found genera on one sex alone if it can possibly be avoided. The maxillary palpi in *Anthobosca* are six-jointed, not as Cameron, following Ashmead, states, five-jointed.

The genus *Æluroides* described as a Thynnid by Tullgren (Arkiv. Zool., i, 1904) for *A. sjöstedti* is erroneously placed, and is synonymous with *Apenesia*, Westw., belonging to the Proctotrupidæ. It appears, therefore, that unless we place *Methoca* in the Thynnidæ, the family does not occur in Africa. *Methoca* in my opinion has had an origin independent of the Thynnidæ.

VI. *Two New* Diplopterous Hymenoptera *from Queensland.*

By Rowland E. Turner.

[Read February 5th, 1908.]

Family MASARIDÆ.

Paragia magdalena, n. sp.

♀. Mandibles very broad, tridentate at the apex, the teeth blunt, the outer tooth much the longest. Clypeus convex, much broader than in *P. deceptor*, Sm., broadly truncate at the apex, closely and rather coarsely punctured. Head rugose; the front between the antennæ slightly raised; the inner margin of the eyes shallowly, but widely, emarginate near the vertex; the ocelli in a broad triangle, the two posterior ocelli much further from each other than from the anterior one, about half as far again from the eyes as from each other. Thorax coarsely rugose; the pronotum narrower than the head and rounded anteriorly, very strongly arched posteriorly. Mesonotum much longer than broad, with a faint median sulca anteriorly, and a deep curved sulca on each side diverging towards the anterior margin. Scutellum not very large, raised a little above the mesonotum. Postscutellum and median segment depressed below the scutellum, the median segment short, truncate and narrowed to the apex, the angles rounded and without spines, closely punctured and pubescent. Abdomen closely punctured, with short pubescence; the first segment truncate anteriorly, much narrower than the second.

Black; the mandibles fusco-ferruginous, the legs light ferruginous shading to yellow; the basal two-thirds of the clypeus, a large spot between the antennæ, the inner orbits of the eyes, most broadly near the summit and interrupted in the middle, a spot on the outer orbit near the summit, a large subtriangular spot on each side of the pronotum, a spot on the mesopleuræ below the anterior wing, the tegulæ and a short line above them, a large spot on the middle of the scutellum, a small spot on each side of the median segment, a transverse band broad on the sides but almost interrupted in the middle at the apex of the first abdominal segment, the third segment, except at the base, the apical half of the fourth segment and the whole of the two apical segments orange-yellow; the second, fourth and fifth ventral segments very narrowly and the third more broadly margined with yellow at the apex; the apical segment ferruginous brown. Wings flavo-hyaline,

the anterior wings stained with fuscous along the costa, nervures black.

Length 16 mm., exp. 22 mm.

Hab. MACKAY, Queensland (*Turner*).
Nearest to *deceptor*, Sm.

Family EUMENIDÆ.

Euchalcomenes, n. gen.

♀. Mandibles long and broad, forming a rostrum, obtuse at the apex, with three short, strong, blunt teeth along the inner margin, deeply furrowed above. Maxillary palpi four-jointed, the first joint very long, as long as the other joints combined, the second longer than the third, the fourth very short, slender and pointed. Labial palpi four-jointed, short and slender. Clypeus pyriform; the labrum projecting beyond the apex, very narrowly linguiform. Head of the same breadth as the thorax; the eyes very deeply emarginate; the antennæ thickened gradually to the apex, the flagellum twice as long as the scape. Pronotum truncate anteriorly; the median segment short, very steeply sloped posteriorly and deeply longitudinally divided. First abdominal segment slender at the extreme base, then widened and bell-shaped, nearly half as wide at the apex as the second segment, which is longer than the first. The spine at the apex of the intermediate tibiæ is very short; the tarsal ungues are bidentate. The first recurrent nervure is received just before the middle of the second cubital cell, the second is interstitial with the second transverse cubital nervure. The radial cell is broad, shortly appendiculate; the first cubital cell is considerably longer on the cubital nervure than the second and third united; the second is very narrow on the radial nervure, almost triangular; the third rhomboidal, hardly broader on the cubital than on the radial nervure.

Type *E. gilberti*, n. sp.
Pachymenes viridis, Sm., from Aru and *P. elegans*, Sm., from Batchian also belong to the genus, which is quite distinct from the American *Pachymenes*, in which the maxillary palpi are six-jointed as in *Eumenes*.

Euchalcomenes gilberti, n. sp.

♀. Clypeus very narrowly truncate at the apex. A short longitudinal carina between the antennæ, which are twice as far from each other at the base as from the eyes. The whole insect deeply and

closely punctured, most coarsely on the head. Scutellum subrectangular, nearly twice as broad as long; postscutellum depressed in the middle.

Bronze-green; the flagellum above fuscous; the mandibles, antennæ, tibiæ, tarsi, the apex of the femora, the apex of abdominal segments 2–5 narrowly and the apical segment except the extreme base ferruginous brown. Wings pale flavo-hyaline, tinged with ferruginous on the costa, nervures ferruginous.

Length 17 mm., exp. 26 mm.

Hab. KURANDA, near Cairns, Q. (*Turner*), February.

Both of the species described above are from the collection of the late Gilbert Turner. The types will be placed in the British Museum.

VII. *On Diaposematism, with reference to some limitations of the Müllerian Hypothesis of Mimicry.* By Guy A. K. Marshall, F.Z.S.

[Read February 5th, 1908.]

One of the most striking features in connection with the philosophical study of the phenomena of Mimicry among butterflies in recent years has been the marked tendency to lay an ever increasing emphasis upon the importance of the selective factors suggested by Fritz Müller and to minimise the influence of what is known as Batesian Mimicry. It has even been suggested that every known case of mimicry among butterflies can be more satisfactorily interpreted as being due to the operation of Müller's principle. The essential difference between these two theories of mimicry lies in the fact that one explains how an edible (or less unpalatable) species will derive advantage through assuming a superficial likeness to another which possesses nauseous (or more unpalatable) qualities (Batesian mimicry); whereas the other shows how one nauseous species will benefit by mimicking another having the same qualities (Müllerian mimicry). Now although there can be little doubt that a good many cases of mimicry originally adduced in support of Bates' theory must now be explained on Müllerian lines; yet the universal application of this latter principle to butterflies, involving, as it does, the assumption of unpalatability in every mimic, seems open to some serious objections which may be considered later.

Perhaps the principal stimulus to the recent extension of Müller's interpretation of mimetic resemblances has been furnished by an hypothesis which has been developed by Dr. F. A. Dixey. It was in his important and able memoir on the Phylogeny of the Pierinæ (Trans. Ent. Soc., 1894, pp. 249–334) that Dr. Dixey first outlined his conception of Diaposematism, or Reciprocal Mimicry, as it was then called. This conception consists practically of a widening or complication of the principle put forward by Müller to explain the inter-resemblances between distasteful butterflies belonging to different genera. For

although Müller evidently conceived, and briefly mentioned, the possibility of a mutual approach between two such species (Proc. Ent. Soc. 1879, p. xxviii), yet his theory was generally interpreted as involving only a one-sided approach from one species to another. On the other hand the hypothesis of Diaposematism specially emphasises the probability of a mutual simultaneous approach. To use the author's own words: "There seems to be no reason why, especially if there is no conspicuous inequality of numbers, there should not be a kind of 'give and take' arrangement between mimicker and mimicked, the latter advancing some way to meet the former for their mutual benefit. In other words, when two species, A and B, form an association of this kind, it need not be supposed that the form of A remains fixed, while B assimilates itself to it, or *vice versa*; but the association may really be formed by both A and B converging to a point between them, or, in short, mimicking each other. The acceleration of the process, which in many cases would result, must of itself be an advantage." (Trans. Ent. Soc. 1894, p. 297.) And again: "In the latter case (Müllerian Mimicry) the mimetic attraction is unlimited and mutual, acting reciprocally in both directions, and influencing each member of the group." (Trans. Ent. Soc. 1897, p. 325.) This line of argument was also advocated in the Transactions for 1896 (p. 72), and since that time various specific cases have been published by Dr. Dixey, Professor Poulton and Mr. S. A. Neave, which are considered to furnish convincing proof of the validity of the hypothesis of reciprocal mimicry. Indeed, it has been held that these proofs are so cogent that Diaposematism should no longer be regarded as a mere hypothesis, but that it is now entitled to rank as an established law (Proc. Ent. Soc. 1906, p. lxxi).

But before looking into the details of these cases it may be well to examine the whole conception from a more general standpoint. It has already been remarked that reciprocal mimicry is merely a complication of Müller's theory, and it is therefore important to have a very clear idea of the essential nature of that theory, of the factors which make for a Müllerian Association, and of the conditions which are most favourable to its development. The real starting-point for the Müllerian hypothesis lies in the proposition (sufficiently well established by now)

that young insectivorous animals are not born with an instinctive knowledge of what insects are good to eat and what are not. The slow flaunting flight and conspicuous coloration of a *Danaida* or a *Heliconius* can have no special significance for a young bird when it first starts out in life to forage for itself. The knowledge that these butterflies possess a pronouncedly unpleasant flavour can only be acquired as the result of direct experiment, and probably several butterflies would be destroyed by such a bird before it succeeded in permanently associating the conception of unpleasantness with any particular colour-pattern. Thus each species with an independent type of warning coloration would have to lose a certain percentage of its individuals before its true significance could become a matter of common knowledge among all the young and inexperienced insect-eaters in any particular neighbourhood. From this Müller argued that if two such species, having different colour-patterns and inhabiting the same area, were to develop the necessary variations leading up to a mimetic association, such a combination would be of considerable utility in relation to the experimental tasting of young birds; for then both species together would only have to contribute the same number of victims which each of them would have to furnish if their colours were different.

Given the initial variation, such a mimetic resemblance can only be built up through the operation of some eliminative or selective factors which shall result in an advantage to the variation as compared with the typical form from which it is derived; thus leading up to the gradual replacement of the latter by the former. And it may be noted that, with the exception of resemblances in which mere affinity has obviously played a great part, the closer the mimicry, the greater must have been the persecution of the mimic (whether Batesian or Müllerian) and the higher the percentage of its elimination. In the case of Müllerian mimicry, as we have seen, the selective agent is provided by the destruction due to the experimental tasting of unpalatable insects by inexperienced insectivorous animals. This may be briefly denoted as the "Müllerian factor."

There are certain points in connection with the operation of this factor which it is well to bear in mind. In the first place, the differences in the relative intelligence of

the butterflies' enemies will affect the results due to their attacks. Those which exhibit a high degree of intelligence will obviously profit more quickly by their experience; in other words, they will acquire the necessary mental association between colour and inedibility by the destruction of comparatively few butterflies. They will therefore operate much less efficiently as producers of Müllerian mimicry than will those enemies which have a comparatively low degree of intelligence and which therefore require to make many experiments before arriving at the same result. But if there be enemies still lower in the scale and incapable of forming such a mental association at all, then the destruction of butterflies which they would cause would have no effect whatever from a purely mimetic standpoint; no more than if the insects had been killed by a torrential thunderstorm. Similarly if we suppose that a certain species of bird has specially adapted itself to feed on a genus of insects usually avoided by other insectivorous animals, the attacks of that bird will have no effect in the direction of Müllerian mimicry on that particular genus. In other words, the mental attitude of the enemy towards its prey has an important bearing upon the results which its attacks will produce. Finally, the accumulation of experience does not render an animal more effective as a Müllerian factor, but precisely the reverse; for as it becomes more skilled in recognising nauseous species, so will it gradually cease its experimental destruction, upon which this kind of mimicry so essentially depends.

If we turn for a moment to consider whether these arguments are equally applicable in the case of Batesian mimicry, we find, on the contrary, a totally different state of affairs. So far from experience and intelligence being adverse qualities, it is evident that the greater the accumulation of experience and the higher the degree of intelligence possessed by the insectivorous animal, the greater will be its efficiency as a producer of Batesian mimicry. For it will thus be the better enabled to discriminate between the edible mimic and its inedible model, with the result that there will be a more effective selection and a keener elimination of those variations of the mimic which do not come up to a high standard of resemblance. A consideration of this difference in the operation of these two mimetic forces would appear to

justify the expectation that the elimination due to the Batesian factor would be competent to produce a higher degree of inter-resemblance than would the factor adduced by Fritz Müller.

Another point worth noting is the difference in the periods of incidence of these two processes of selection. The Müllerian factor is, as we have seen, supplied entirely by young and inexperienced birds, etc.; it will therefore have its greatest effect during the summer months when such young animals would be most numerous. As the season advances, however, these animals would be increasing in wisdom and experience, and consequently by the autumn or early winter we may reasonably suppose that their efficiency as producers of Müllerian associations will have very notably diminished. Now from this time onwards until the early months of the next summer there will be no further appearance of young broods of insectivorous animals; and it seems clear that for a considerable portion of the year the forces which make for Müllerianism will be at a very low ebb, if not altogether absent. On the other hand, there seem to be no grounds for assuming the existence of any such period of marked diminution in the factors which make for Batesian mimicry; for in most tropical countries butterflies (which are here alone being considered) are fairly plentiful throughout even the winter months, while there is a much greater reduction in the insects of most other orders (*cf.* Trans. Ent. Soc. 1902, p. 432). Thus, although a large number of insectivorous migrants will have departed at that season, the scarcity of other insects, in conjunction with the comparative conspicuousness of butterflies, will doubtless lead to a maintenance, or even an increase, of the percentage of destruction by the remaining resident birds. The incidence of Batesian elimination, therefore, will be comparatively continuous and persistent.

Having thus briefly examined some aspects of Müller's selective factor, we may now endeavour to ascertain the conditions which will render it most effective in fostering mimetic associations. The position of affairs will be best appreciated by taking some hypothetical case. Let us assume therefore that within any given area there exist two species of butterflies, A and B, possessing nauseous qualities in about the same degree, but having different warning colour-patterns; and further that within the

same area the education of young birds, lizards, etc., necessitates the destruction of approximately 1000 individuals in each group of distinctive patterns. Again, let us suppose that A is a common species and is represented by 100,000 individuals in that locality, while B is more scarce and has only 5000. Now, *ex hypothesi*, the Müllerian factor will exact an equal toll from the two species, and its selective importance must therefore depend upon their relative numbers. In the present instance the plentiful A will lose only 1 per cent. of its individuals from this cause, while the scarcer B will lose no less than 20 per cent. It is therefore reasonable to suppose that if certain individuals of B chanced to develop a variation in the direction of A, that variation would have, in relation to the Müllerian factor, a definite advantage over its own typical form, because it would tend to share, at least to a small extent, in the relative advantage enjoyed by A; and the continuance of the elimination would gradually tend to enhance the variety and to diminish, and finally exterminate, the type. This would be a case of simple Müllerian approach from B to A. But if the mimicry is to be reciprocal it must be shown that A is capable of approaching B by a precisely similar process. In order to simplify the argument let us make the supposition that 10,000 specimens of A simultaneously present a sudden marked variation in the direction of B, to such an extent that young birds would be liable to rank them with B rather than with A; what will be the effect of the Müllerian factor on this remarkable variety? The point again to be considered is the relative incidence of the destruction. There will now be 90,000 examples of the A pattern, and 15,000 of the B pattern. If 1000 individuals of each are again destroyed by experimental tasting, a simple calculation shows that the percentage of loss due to this factor will be six times greater in the variety of A than in the typical form of A. In fact the result is exactly the opposite of what took place in the case of the variety from B towards A. Whereas there we found that the variety had an appreciable advantage over its own type form, here it is seen to be at a distinct disadvantage. It is obviously impossible for the Müllerian factor to build up a mimetic resemblance on such a foundation; if it have effect at all, that effect must be to gradually eliminate the variety and to establish

the type form. In these particular circumstances it is clear that the simultaneous and mutual mimicry, postulated by the hypothesis of Diaposematism, is entirely out of the question. The Müllerian factor is capable of converting B into a mimic of A, but it cannot cause A to mimic B.

This simple example illustrates several interesting points. In the first place, it shows that the whole idea of Müllerian mimicry practically resolves itself into a numerical computation of the relative percentages of loss. The only kind of variation which can have any significance will be one that shall be trending from a form having a higher percentage of loss towards one having a lower percentage; so that a difference in these percentages is an essential condition for the production of Müllerian mimicry. But Müller's hypothesis postulates that the absolute destruction is practically constant for each group of different colours, and therefore the necessary conditions can arise only where there is a noticeable difference in the initial numbers of the two species involved. Further, the greater the discrepany between these two numbers, the greater will be the advantage derived by any variation from the rarer species in the direction of the more numerous, and consequently the more powerful and rapid will be the operation of the Müllerian factor in producing a mimetic approach. This therefore constitutes the most highly favourable condition for the evolution of Müllerian mimicry. Conversely, as the numbers approach one another, so will the value and importance of the initial variation from the numerically smaller species towards the larger become less and less; so too will steadily diminish the effectiveness of the Müllerian factor as a producer of mimicry. Finally, when we arrive at a case where the two species are equal in numbers, there will then be a condition of equilibrium, and the Müllerian principle will practically cease to operate altogether.

So far as concerns the variations which may arise from the numerically larger species towards the smaller, these will be the more rapidly exterminated, the greater the discrepancy in the numbers of the two species. As this difference diminishes, the disadvantage of such a variety, as compared with its typical form, will also diminish; but in no case can its development be fostered and increased through the medium of the Müllerian factor, because it still remains a variation in a disadvantageous direction.

Further, as the numbers approach each other, any variation from the larger towards the smaller tends to produce equality, a condition which effectively prevents the Müllerian selection from producing any mimetic results. We see then that a Müllerian approach will only take place in one direction, namely, from a rarer species towards a more abundant one, and no species can in this way approach another which has fewer individuals (and therefore a higher percentage of loss) than itself.

If this conception of the conditions which make for Müllerian mimicry be accepted as sound, it would appear that the hypothesis of Diaposematism is placed on the horns of a veritable dilemma. For this hypothesis differs in no real essential from Müller's principle, of which it appears to be merely an extension; and yet we find that the very conditions which are most highly favourable for a simple Müllerian approach are at the same time absolutely fatal to anything in the way of reciprocal mimicry. On the other hand, this latter conception only begins to appear feasible at the other end of the series, namely, where the numbers of the two species approximate equality. But we have seen that this is a condition which renders any occurrence of Müllerian mimicry in the highest degree improbable; and there can be no Diaposematism where there is no Müllerian mimicry. In my opinion, the above considerations render it difficult to accept the essential idea of reciprocal mimicry even as a mere working hypothesis.

Now it may be urged that the statement as to the practical impossibility of Müllerian mimicry when the numbers of the two species are equal cannot be maintained, and that its unsoundness can be demonstrated by some such illustration as the following. Supposing that A and B are each represented by 20,000 individuals and that they lose 1000 apiece from experimental tasting when their colours are different; then if they enter into a mimetic association they will only lose 1000 out of 40,000; in other words, their losses from this cause will be reduced by one-half. Here is a clear and decided advantage, and therefore it may be claimed that the Müllerian factor must have scope to produce such a mimetic approach.

But before hastening to accept this conclusion it is well

to point out that unless due care be exercised in the use of this kind of argument from advantage, it is liable to lead to erroneous conceptions. In order to show this more clearly let us apply the same line of argument to a slightly different case. If we suppose that there are 20,000 examples of A and only 10,000 of B, each losing 1000; then when A stands alone it will lose 5 per cent. of its numbers. But if A develops a mimetic tendency in the direction of B, and finally becomes a mimic of that species, then its loss from experiments will be reduced to only $3\frac{1}{3}$ per cent. Here again there is a clear advantage as compared with its previous condition, therefore it will be claimed that the Müllerian factor must be capable of converting A into a mimic of B.

Now we have already seen that where the numbers of A are considerably in excess of those of B, as in this case, any initial variation (in the Darwinian sense) from A towards B will be going from a lower percentage of loss in the direction of a higher percentage, and that therefore that variation will be at a disadvantage as compared with its own type form, in relation to the factor which is causing the loss. In such circumstances therefore the Müllerian factor cannot convert A into a mimic of B.

Here then these two lines of argument, based on the same data, have led to diametrically opposite results. The reason for this divergence is not far to seek. It will be observed that the contention in favour of a Müllerian approach from A to B is based entirely on a consideration of the advantage which would accrue *when the mimicry had become an accomplished fact,* while the intermediate stages are in no way taken into account. But the whole Darwinian idea of the evolution of such a case of mimicry involves the assumption that it has been built up by a gradual process of selection from comparatively small individual variations. Therefore the essential point to be considered must be the question of relative advantage as between the *initial* variation and its typical form; and the assumed ultimate advantage has no real significance unless it can be shown that the initial variation has some definite advantage over the type in relation to the selective factor which is considered to cause the mimetic approach. Where this point is overlooked, an argument based merely on a supposed eventual gain may, in some cases, be entirely misleading.

On reverting to the case where the two species have equal numbers and applying the above test, we find that the contention in favour of a Müllerian approach cannot reasonably be maintained. If A and B are equal, then their position in regard to the Müllerian factor is absolutely identical, so that neither has an iota of advantage over the other and the essential condition for the origin of Müllerian mimicry is lacking. In these circumstances it is evident that any small variation from one towards the other will not practically affect the numerical relationship of the two species and will therefore have no mimetic value.

The comparative numbers of individuals in Müllerian Associations.

Unfortunately we have very little knowledge as to the approximate individual numbers of the species forming any Müllerian association; but in November 1903, Professor Poulton exhibited to this Society (Proc. Ent. Soc. 1903, p. liv) a series of 323 butterflies captured on a single day by Mr. C. B. Roberts in British Guiana, with a view to giving an idea of the relative numbers of the species in that spot. Out of the total no less than 295 specimens, comprising 9 species, fell into the mimetic association which centres round the common *Melinæa mneme*, all of them belonging to undoubtedly distasteful genera. *M. mneme* itself vastly outnumbered the other species, being represented by 253 individuals, while the remaining 8 species were represented by the following numbers: 8, 9, 10, 9, 1, 3, 1, 1. There seem good grounds for supposing that these figures do give a fair rough idea as to the relative occurrence of these species in that locality, and the very striking discrepancy in the numbers of the mimics as compared with their dominant model is precisely what we should expect to find on the conception of Müllerian mimicry here advocated. Such conditions would be specially favourable to the production of a large mimetic association, and it seems highly probable that in actual practice Müllerian mimicry will only have arisen where the discrepancy in numbers has been fairly considerable; although the possibility of its occurrence where the difference is comparatively small can, of course, be theoretically upheld.

Alternating Resemblance.

Although there appear to be serious difficulties in the way of accepting any idea of mutual simultaneous mimicry between two unpalatable species, yet it is not impossible that a certain interchange of characters might still take place between them. For example, at first A might be more numerous than B and a simple Müllerian approach might take place from B towards A. While this was in progress conditions might arise which would cause a reversal in the relative numbers of the two species, so that B would become the dominant partner. Then any further mimetic approach that might take place would be from A towards B, so that the final result might show a fusion of the original colours of the two species. This kind of approach is quite different from that contemplated in the hypothesis of Reciprocal Resemblance, although producing similar results; it may therefore be distinguished under the name of Alternating Resemblance. It is not probable that this phenomenon will be of common occurrence in nature, and it is only here referred to in order to show that even if the actual existence of reciprocity can be demonstrated, that will not of itself afford proof of Diaposematism; for the facts can be consistently interpreted on the lines of a one-sided Müllerian approach.

Since the foregoing remarks were written Professor Poulton has kindly suggested to me a criticism which appears, at first sight, to lend some support to the idea of Diaposematism. As a very similar suggestion has been made to me independently by another friend, it seems advisable to show how it may be met.

It has been contended that among the enemies of the two distasteful butterflies, A and B, there will be some (which we may call X) whose first experience will be entirely of A. Having thoroughly learnt that this insect is unpalatable they will then come across B. If among the individuals of B there occurs a variation (B′) which presents a roughly A-like appearance, then B′ will have an advantage over B in relation to the attacks of X. Similarly other enemies (Z) will first have experience of B only, so that when they afterwards attack A, the variety A′, which has varied in the direction of B, will be at an advantage as compared with A, because it will recall to

the mind of the enemy unpleasant experiences in connection with B. On these grounds it is argued that both varieties, A′ and B′, are advantageous, and that therefore the two species can mimetically approach one another at the same time. But a little consideration will soon show that the above argument does not deal with all the factors in the case. In the first place, the enemies are divided into only two categories (X and Z); but there must obviously be a third (Y) which will derive its knowledge through a mixed experience of A and B together, and the effect of this has been quite left out of consideration. Now it is evident that reciprocal mimicry could only take place where A and B are approximately equal. When this is the case, the law of probabilities shows that the numbers of Y will be very large, those of X and Z very small; therefore the net result of the Müllerian factor will depend upon the effect produced by Y, and this is entirely covered by the general argument set forth above, which thus remains unaffected.

There is yet another more important objection to this criticism. It is contended that X will discriminate between B and B′, and Z between A and A′, to the advantage of B′ and A′ respectively; but the relation of X to A and A′, and Z to B and B′ is not taken into account at all. But if A′ is sufficiently different from A that Z will discriminate between them, it must be admitted that X will do so likewise. Such discrimination means that A′ will be subjected to special tasting experiments by X, as apart from A. But *ex hypothesi* the numbers of A′ will be very much smaller than those of A, and therefore these experiments will involve a much higher percentage of loss for A′ than for A, so that the former will be at a decided *disadvantage* in relation to the attacks of X. The same applies to B′ with regard to the attacks of Z. Thus A′ will have an advantage over A during the attacks of Z, and a disadvantage during those of X, and the net result will depend upon the relative numbers of X and Z. But the relative numbers of X and Z are directly dependent on the relative numbers of A and B respectively; for where A is abundant the members of X will be large and *vice versa*. Therefore when A and B are equal, X and Z will be equal, and the advantage which A′ derives from Z will be balanced by the disadvantage due to X; and similarly for B′. In these circumstances there will be a condition of

equilibrium so far as concerns the Müllerian factor, and no mimetic approach will take place. Again, where A is largely in excess of B, X will be large and Z small; therefore the disadvantage accruing to A′ will be large, the advantage small, the net result being a considerable disadvantage; so that the effect of the Müllerian factor will be to stamp out A′ and to establish A, in other words, to prevent its mimicking B. It is thus evident that so far from upsetting my general argument this criticism merely serves to confirm it when all the factors are taken into account.

We may now turn to an examination of the various cases which have been cited as furnishing conclusive evidence as to the actual occurrence of diaposematic resemblances. In looking at these as a whole an interesting fact emerges, namely, that no example has yet been brought forward as occurring between any two of the most dominant distasteful groups of the world, viz.: Danaini, Euplœini, Lycoræini, Ithomiinæ, Heliconinæ and Acræinæ; although it is among some of these groups that Müllerian mimicry finds its highest development, and cases of reciprocity should be evident and numerous, if Diaposematism be a *vera causa*. Perhaps it is a mere coincidence that in the great majority of instances cited (5 out of 7) one of the mimetic forms belongs to a species not generally considered to be unpalatable. But it has been claimed that the establishment of a case of diaposematic resemblance is of itself good evidence of the unpalatability of both species involved. This claim is obviously justifiable only where it can be shown that it is impossible to interpret the facts on any hypothesis other than Diaposematism; and such a case has not yet come under my notice. It was in connection with this aspect of the question that I first found myself in conflict with this theory; for its application has led to the assumption that the coloration of certain South African butterflies has a warning significance, indicating the existence of distasteful qualities, whereas my own observation of the insects in the field (supported by a few experiments) has led me to an entirely opposite conclusion. These divergent results have induced me to undertake a closer examination of the foundations upon which the hypothesis of Diaposematism has been built.

I. *The Association of* Pereute *and* Heliconius.

This case is of special interest because, with the next one, it furnished the original basis for the theory we are considering. It was dealt with by Dr. Dixey in Trans. Ent. Soc. 1894, p. 296, and further discussed in the Trans. for 1896 (p. 72). The facts are briefly these: Certain forms of the Pierine genus *Pereute* in Tropical America exhibit an undoubted mimetic approach towards the common *Heliconius melpomene* and its allies, whose upper-side colouring is plain brown, with a broad red band across the fore-wings. Now many species of *Pereute* have on the under-side some distinct red spots at the base of the hind-wing. Somewhat similar markings also occur in the *Heliconii*, but Dr. Dixey, quite justifiably, refuses the explanation that these spots have been acquired by the *Pereute* as part of their mimetic resemblance to *Heliconius*. For he shows that not only can we find similar markings in other American Pierines which have no mimetic relationship with *Heliconius* or any of the red-spotted Papilios, but further they are shown to occur independently in Pierine genera in other parts of the world; notably in some species of the distasteful Eastern genus *Delias*, to which he considers *Pereute* to be nearly allied. On these grounds the spots are claimed as being Pierine in character. How then are we to explain their presence in *Heliconius*? Any argument for parallel development is rejected by Dr. Dixey, for he says: "If we assert them to be purely 'accidental,' we are met by the fact that although they are found in some species of both *Papilio* and *Heliconius* that are apparently not the subject of mimicry, yet they are most distinct and most prevalent in those species which are copied by Pierine imitators" (*l. c.* 1894, p. 296). Hence it is contended that the only satisfactory explanation is that, in this particular respect, the *Heliconii* have been influenced by, and approached, the *Pereute*, and that therefore the red spots constitute a reciprocal or diaposematic character.

Now, in order that any case of this kind may really carry conviction as a proof of diaposematism it is necessary to show that the reciprocal character which the model is claimed to have acquired from the mimic must be one that is abnormal in the genus of the model and its allies. For if the character occurs frequently and independently

in other members of the same genus its appearance in any one species might well be due to simple affinity with them and not to mimicry at all. The fact that the model and the mimic possessed *ab initio* certain superficial characters in common would of itself render a mimetic approach the more probable; yet the occurrence of these similar markings would, in no sense, be due to mimicry, and no argument for diaposematism could be founded upon them.

The first point therefore to be investigated is the occurrence of this red spotting in *Heliconius*. With the accession of the splendid Godman and Salvin collection the British Museum now possesses a very fine series of this genus. A careful examination of this material, based on Riffarth and Stichel's monograph of *Heliconius* in the "Theirreich," shows that out of the 71 species recognised by these authors no less than 35 * possess basal red spots on the under-side of the hind-wings. Of the remaining 36 species about three-fourths have been drawn away in mimicry of the great *Melinæa-Mechanitis* association, and the absence of red spots may perhaps be actually due to this mimicry; for I have been unable to find that any genus of Ithomiinæ or Danainæ possesses this kind of marking. The *Heliconii* in which the red spots are present belong to various different types of coloration, several of which do not appear to be mimicked by Pierines, and in some of these the red spots are very highly developed, more so than in any non-mimetic American Pierines. Nor does there appear to be any constant connection between general mimicry and the development of the spots. For example, *Pieris locusta* ♀ roughly mimics *H. cydno-galanthus*, and the nearly allied *P. noctipennis* ♀ mimics *H. sapho-leuce* (Dixey, "Nature," Oct. 1907, p. 677); the under-side red spots of the two *Pieris* are almost identical, yet those of the *Heliconius* differ very much from them and from each other.

Turning now to *Pereute* we find that the colour of the under-side of the hind-wing may be generally described as dark brown with a variable yellow costal streak, and with, or without, two or three basal red spots. With regard to the upper-side colouring the genus may be

* It may be noted that the great majority of these species also have a red streak along the base of the costa of the fore-wing on the under-side, a character which I have failed to find in any American Pierines.

divided into three sections. In the first, comprising only the more primitive *telthusa*, the sexes are alike, being blackish, with white markings and an irroration of grey scaling; the under-side having *three* red spots. In the second the sexes are again alike, both being black, with a red bar across the fore-wing and with a very striking broad blue-grey suffusion over the bases of both wings; inferior red spots (two) present or absent. Finally, in the third section, the sexes are different, the males being blackish-brown with general grey irroration; while the females are brown, with a pink or red bar in the fore-wing, having a basal grey suffusion in the former case, and none in the latter; inferior red spots (two) present or absent. There is obviously no mimicry of *H. melpomene* in the first section; neither can its occurrence, so far as concerns the upper-side, be reasonably claimed in the second. For although the red bar in the fore-wing may be urged as a mimetic character, this is rendered highly improbable by the presence of the striking basal pale marking, which, with the black ground-colour, gives the insects a totally different appearance. It is only in the third section that we find any real mimicry, namely, in the females of *charops*, *venezuelana* and *peruviana*, the last two being probably only local races of the first. These forms being brown and having lost all traces of the pale suffusion, do very convincingly suggest the existence of a close mimetic association with *H. melpomene*. Here, if anywhere, there should be evidence of reciprocal mimicry; but unfortunately for the hypothesis *charops* happens to be one of the species of *Pereute* which does not possess any red spots at all on the under-side, and this fact alone renders it highly improbable that the spots of *melpomene* are diaposematic. It appears even open to doubt whether they have any real mimetic value at all. In *Pereute* they occur most markedly in the more primitive, and apparently non-mimetic, *telthusa*, and yet they have actually been lost in *P. charops*, although it closely mimics a *Heliconius* in which they are present. How then can we consider that these spots are so important that they have been modified in *melpomene* by the influence of the very different *P. leucodrosime* (belonging to section 2), especially when it is noted that they differ considerably both in number and position in the two species? Further, if their mimetic value is so

great, how can we explain their absence in *P. callinice* which in other respects so closely resembles *P. leucodrosime*? A general contemplation of all the facts must, I think, inevitably lead to the conclusion that these red spots have been quite independently developed in *Heliconius* and without any Pierine influence whatever.

II. *The under-side red spots in the Pierine*, Archonias tereas, *and* Papilio zacynthus.

This case was originally put forward in conjunction with the preceding one, and will be found under the same references. For various reasons it is advisable to treat it separately. The line of argument in favour of Diaposematism is quite similar, it being contended that though the Pierine has evidently mimicked the Papilio in all its principal characters, yet in the case of the red spotting of the under-side the influence has been in an opposite direction.

We may first consider the red markings in *Archonias*. The genus falls into four sections, so far as mere pattern is concerned. The first section comprises a single species, *theano*, which evidently represents the more primitive colouring of the genus. Its upper-side is dark brown, with vague whitish markings, while the under-side presents a very characteristically Pierine appearance, being yellowish or whitish with a broad white-spotted dark border and the nervules broadly darkened; a colour scheme which continually reasserts itself in various genera of Pierinæ in all parts of the world; finally the basal red spots are conspicuous by their absence. The second section contains species which mimic various Ithomiinæ, and in all of them the red spots are wanting. The species of the third section mimic certain *Aristolochia* Papilios and these gradually merge into the fourth section which has developed *Heliconius*-like colours. In these last two sections the species all exhibit two red basal spots below, though these differ in position from those of *Pereute*. In the latter the spots are situated obviously on the wing, while in *Archonias* they are placed on the extreme edge of the base and on that portion which is bent against the thorax, so that they appear, unless closely examined, to be

actually on the thorax itself. When we turn to *P. zacynthus* and its allies we find that they have no red spots on the wing, but only on the thorax; a condition which is highly characteristic of *Papilio*, but which never occurs, so far as I am aware, in any Pierine. At first sight it might appear as if this furnished good evidence as to *Archonias* having mimicked the *Papilio* in this respect, especially as the most primitive species has no red spots at all. But this view is rendered less probable by the occurrence of similarly placed markings in various non-mimetic species of *Catasticta* and other closely allied Pierine genera. On the other hand, Dr. Dixey advocates the opposite view, namely, that the Pierine has influenced the *Papilio*. But a consideration of the prevalence of these red spots in the latter genus shows that this suggestion is even less probable than the other.

In Rothschild and Jordan's revision of the American Papilios (Nov. Zool., 1906, p. 435) these insects are divided into three sections. The first of these, the *Aristolochia* Papilios, again fall into four groups. Now the first three groups contain no less than 45 species every one of which has thoracic spots like those of *P. zacynthus* (which belongs to the third group), although many of the species have no mimetic relations with any Pierines. In the fourth group the red spots are replaced by yellow or white, except in the case of *polydamas* and its numerous races, in which the spots are red and there is in addition a red spot at the base of the hind-wing. Again, basal red-spots on the hind-wing are to be found in a considerable number of American Papilios belonging to Section III, in which there can be no question of Pierine influence. If we turn to the East we find a precisely similar state of affairs, namely, numerous species of quite differently coloured Papilios, including most of the splendid Ornithopteras, which have developed either red spots on the thorax, or on the base of the hind-wing (sometimes to a very remarkable extent), or on both. He who will be at the pains to investigate these facts for himself must, I think, unhesitatingly reject any argument for Diaposematism in this particular instance. The evidence in favour of an entirely independent development by the Papilios of these distinctive markings appears to be overwhelming.

III. *Why do both sexes of* Archonias tereas *mimic only the female of* Papilio zacynthus?

A second argument for Diaposematism has been based on these same two species, considered from a somewhat different standpoint. The case was stated as follows: "So far as I am aware no explanation has yet been offered of the fact that it is the females and not the males of *Papilio polymetus, P. zacynthus*, etc., that are resembled by *Euterpe tereas* and *E. critias*; whereas the males, which display brighter colours, afford at least as good, if not better, models for imitation. I would suggest that this is really due to 'reciprocal mimicry.' The protection gained by the resemblance between the Pierines and the Papilios is not all on the side of the Pierines, but mutual; and the female Papilios have, as is usual, felt the need of it more urgently than the males. For this reason the female Papilios have been led to meet the Pierines by discarding, or at any rate by not adopting, the bright metallic-blues and greens that ornament the other sex." (Trans. Ent. Soc. 1894, p. 298, note.)

The colour of the ♂ *P. zacynthus* differs principally from that of the ♀ in that the posterior two-thirds of the fore-wing patch is covered with metallic-green or blue scales, only the anterior portion being white; whereas in the ♀ the whole patch is white. The contention for reciprocal mimicry here centres entirely on the supposition that it is difficult otherwise to explain why the *Archonias* have not acquired the metallic patches of the male Papilios. In considering this difficulty the first point which suggests itself is to examine the occurrence of metallic colours in other American Pierines. This inquiry reveals the interesting fact that not a single one of these has developed any metallic colours. The same limitation holds good in Asia, as Wallace long ago pointed out, in his classical paper on the Eastern Pierines: "The metallic blue of *Morpho* and of the Lycænidæ, and the rich green of various shades which occurs in most other groups of butterflies are entirely absent" (Trans. Ent. Soc., 1867, p. 301). In fact, so far as I have been able to ascertain, it is only in Africa that any Pierines have developed such metallic scaling, and there it is confined to the males of only two or three species of *Teracolus*. But I cannot find that any Pierine mimic has ever produced this type of

colouring. In these circumstances the supposed difficulty in regard to *Archonias* evidently vanishes. It is no longer remarkable that it has not developed the metallic effects of the ♂ *Papilio*; indeed it would be much more remarkable if it had actually done so. The mimicry has simply followed the line of least resistance, and is in every way consistent with the interpretation of a simple Müllerian approach. It is possible that a fuller knowledge of the habits of the insects would throw more light on the matter; for I note that Wallace mentions that in several species of this group of *Papilio* the sexes do not inhabit the same stations (Trans. Ent. Soc. II, 1854, p. 255).

Another point raised by Dr. Dixey, in support of his interpretation that the *Papilio* has been influenced by the Pierine, is Müller's statement (Proc. Ent. Soc. 1879, p. xxiv) that in the Santa Catharina district of Brazil *Pap. nephalion*, which there represents the model, was comparatively scarce while *Arch. tereas* was common. But in the same paper (p. xxv) Müller has expressly uttered a warning against any such deduction from his statement: 'Thus the black *Archonias tereas*, with the white spots on the margin of the fore-wings and the rose-red of the hind-wings, presents a strange appearance among its congeners, whilst *Papilio nephalion* belongs to a long series of similarly coloured species, so that where this *Papilio* is rare and the *Archonias* common, we cannot for this reason regard the latter as the model of the former." Unfortunately Müller does not mention whether he had observed any other species of the numerous *zacynthus*-like Papilios in Santa Catharina, for this would be of great importance in interpreting the facts. It remains however that all local observers are agreed that the type of colouring exhibited by *zacynthus* is the most characteristic, abundant and dominant *Papilio* pattern in Brazil, and perhaps in Tropical America; nor do any species which I have seen show the least sign of having been influenced by *Archonias*. It may be noted that the mimetic forms of these Pierines persistently retain a characteristic *Archonias* marking, namely, a pale costal streak on the under-side of the hind-wing. Now, if they had really exercised a strong influence on the colouring of the Papilios as suggested, it seems only reasonable to suppose that we should find some effect produced by this characteristic stripe. But no trace of it can be seen either in *P. nephalion* or any other species of the

æneas and *lysander* groups that I have examined. Finally, there does not seem any reason to suppose that in these Papilios the females represent a modification of the male colouring. On the contrary, it appears far more probable that the female pattern is the older, and that the metallic patches of the males are a later development; indeed there are several allied species in which they are non-existent.

IV. *The suggested reciprocal resemblance between* Pieris locusta *and* Heliconius cydno galanthus.

In Trans. Ent. Soc. 1896, p. 72 (note), Dr. Dixey suggested tentatively that *P. locusta* ♂ was a mimic of *Heliconius melpomene*, so far as the under-side of the hind-wing was concerned. In Trans. Ent. Soc. 1897, p. 325, this idea was abandoned, and the very different *H. cydno galanthus* was then definitely proposed as the model. The resemblance however is certainly not of a kind to carry general conviction. The most characteristic feature of the under-side of the *Heliconius* consists of two curved chestnut stripes right across the hind-wing, having their origin at the middle of the inner margin. There is no trace of this marking in *P. locusta*, nor, so far as I am aware, does it occur independently in any American Pierines, although its appearance is simulated in several mimetic species by a prolongation of the lowest basal red spot. But the main point at issue is the contention that "there is more reason to suppose that the *Heliconius* has adopted certain features from the *Pieris* (for example, the whiteness of the ground-colour, and the disposition, if not the existence, of the basal red marks) than that the converse alone has taken place" (*l. c.* p. 327). The reasons in support of this belief are not mentioned, but we have seen above that the contention that the red basal spots have been produced, or even materially affected, in *Heliconius* by Pierine influence cannot be reasonably sustained. It remains only to deal with the proposition that the white area on the under-side of the fore-wing in the *Heliconius* must be explained by its having directly mimicked the Pierine. Now the very position of this white patch is of itself a serious difficulty in the way of such an interpretation. The marking can have no significance during flight, for on its upper-side *P. locusta* ♂ has not the slightest resemblance to the

Heliconius, being an ordinary plain white insect with a moderate black border. On the other hand, in a position of rest this marking would be concealed, and it is therefore difficult to understand what mimetic value it could have. But it is only fair to point out that when the above proposal was made the true ♀ of *P. locusta* was not known, the ♀ figured by Dr. Dixey (*l. c.* Pl. VII, fig. 7) belonging really to *P. tithoreides*, Butl. Now the real ♀ of *locusta*, which is evidently a rare insect, does present a fair general resemblance on the upper-side to *H. c. galanthus*. For the whole of the hind-wing and the basal part of the fore-wing have been very much darkened and thus present a likeness to the similar dark blue areas in the *Heliconius*. We need not therefore labour the point as to the mimicry of *locusta* ♂, but may merely consider whether it is reasonable to suppose that the white patch on the upper-side of the fore-wing of *H. cydno* and its numerous varieties has been produced by their directly mimicking *locusta* ♀.

The first point is the question of unpalatability. In the cases previously discussed there do appear to have been reasonable grounds for suggesting that the Pierines involved were distasteful. Here there appears to be none. Thus *à priori* it seems extremely doubtful that a scarce ♀ Pierine, of questionable unpalatability, should have been able to profoundly modify the colouring of both sexes of an undoubtedly nauseous and abundant species such as *H. cydno*. The crux of the whole argument lies in the assumption that white colouring is abnormal in *Heliconius* and must therefore be due to Pierine influence. Now Riffarth and Stichel recognise 9 sub-species and 5 subsidiary forms of *cydno*. Of these 7 have a conspicuous broad white border in the hind-wing; 3 have this border of a yellow colour, and 4 (including *galanthus*) have no distinct border at all. It seems probable that the borderless *galanthus*-like forms represent the older type, of which the much commoner pale-margined forms are a more recent development. The hind-wings of these latter insects are quite different from anything to be found among American Pierines, and it can scarcely be contested that these broad white margins have been developed by *Heliconius cydno* and *sapho* quite apart from Pierine mimicry; and they have again been independently produced in the very different *H. cyrbia*. Further we may note that in Guiana *H. hecale* presents a large white area in the fore-wing;

while other species of this inordinately variable genus exhibit forms having white patches or bands in the fore-wing. Of these may be mentioned various forms of *sapho, xenoclea-notabilis, anderida-albicilla, antiochus-antiochus, wallacei-wallacci* f. *elsa, wallacci-colon* f. *clytia,* etc., while in such forms as *doris-doris* and *erato-erato* f. *udalrica* the conversion of the yellow discal patch into white crops out as an occasional variation, thus showing an inherent tendency in that direction.

There seem therefore no real grounds for believing that *Heliconius* cannot develop white markings, except under pressure of external mimetic influence, and the most satisfactory interpretation of the present case is that the ♀ *Pieris* is a simple Batesian mimic of the *Heliconius.*

V. *The suggested reciprocal resemblance between the African Papilios of the* zenobia *group and the Acræine genus* Planema.

The normal upper-side colouring of the Papilios of the *zenobia* group may be briefly described as black, with a continuous whitish or yellowish oblique stripe across both wings, which varies in width, and often becomes macular in the fore-wing. There are 12 species recognised by Aurivillius, of which 5 present this type of colouring in both sexes, while in the remaining 7 the female is mimetic of either a *Planema* or an *Amauris* of the *echeria* pattern. In both sexes of all the species there is on the under-side of the hind-wing a large basal triangle of a golden-brown or chocolate-brown colour. In the largest species, such as *cypræofila* and *gallienus,* in which the females are non-mimetic, this triangle attains its greatest size, and is traversed by continuous black inter-nervular streaks. In the mimetic species, as well as the non-mimetic *zenobia,* the streak nearest the costa is broadly divided so as to form two spots. In the females of the mimetic section the brown area is more reduced, causing a considerable shortening of the black streaks nearer the inner margin, and thus producing a more spot-like appearance. In this condition the marking presents an obvious superficial resemblance to the brown, black-spotted area which is found on the hind-wings of so many Planemas. This resemblance has been generally explained as being due to the Papilios being Batesian mimics of the Planemas,

whose unpalatability is well established; a view which is still strongly held by Mr. Trimen. But this idea has been traversed by Prof. Poulton (Trans. Ent. Soc. 1902, p. 488), who claims that the brown triangle is more characteristic of, and more highly developed in, the Papilios than the Planemas. He therefore assumes the Papilios to be unpalatable, and suggests that it is their mimetic influence which has produced the brown triangle in *Planema*; and then subsequently the process has been reversed and the Papilios have begun to mimic the Planemas by a partial conversion of their stripes into spots, this being described as "a late diaposematic response" (*l. c.* p. 489).

Although this suggestion is supposed to indicate a case of diaposematism, it is clear that the interpretation is not really diaposematic, in the sense of suggesting a mutual simultaneous approach. On the contrary, it evidently comes under the heading of what I have termed (p. 103) Alternating Resemblance, and involves the assumption of a corresponding alternation in the individual numbers of the respective species.

The main point at issue is whether these Papilios are really unpalatable, and of this there is no practical evidence. It can only be settled by direct experiment, and by careful observation of the insects in relation to their environment. Personally, I have had experience of only a single species of the group, namely, the extremely local *P. echerioides*. The general behaviour of this insect appears to me to be entirely at variance with the supposition that it is endowed with nauseous qualities, but its habits suggest a possible interpretation of the facts under discussion. In South Africa *P. echerioides* is essentially a forest insect; it is not to be found in open woodlands, but only among dense and heavy timber, coursing irregularly over the undergrowth beneath the trees. In such an environment, lit up by splashes of broken sunlight, the under-surface of the butterfly, as it settles on some low shrub or among dead leaves on the ground, exhibits none of the conspicuous warning characters which have been attributed to it; on the contrary, its colours harmonise most effectively with the surroundings in which it spends most of its time and in which it habitually goes to rest.

The habits of our only *Planema*, *P. aganice*, are very different. For although it is also a lover of forests, it does not fly beneath the trees, but is to be found sailing about

the clearings round the edges of the forest patches; and when it settles there is no attempt at concealment, but it hangs limply from the end of a leaf or bare twig in the full sunlight. In such circumstances the same colour scheme, which in the *Papilio* makes for concealment, becomes conspicuous and obtrusive. But it may be asked, if their habits are so different, how can it benefit the *Papilio* to mimic the *Planema*? The question of food-supply furnishes the answer. In the forest itself flowers are few and far between; they are lovers of sunlight and are to be found principally in the clearings and round the edges of the forest. To such places the *Papilio* resorts to feed; it is here that it comes into contact with the *Planema*; it is here that the forces which make for mimicry find scope to operate.

There seems reason to believe that the Central and West African Papilios of this group have habits similar to those of *echerioides*. The group has probably originated in West Africa and spread thence East and South. The larger species, *cyprævofila* and *gallienus*, with non-mimetic females, appear to be the least modified members of it, judging by their outline and colouring. The large brown triangle of these species, with its unaltered *Papilio* streaks, may then represent a scheme of *cryptic* coloration independently evolved by the group. The roughly *Planema*-like appearance of this pattern would of itself determine a mimicry of *Planema* wherever any species of the group came into special contact with that genus. The resemblance would be enhanced by the breaking of the stripes into spots, and by the reduction in size of the brown triangle, so that it would become, as we see it, smaller in the mimetic female than in its non-mimetic male. That this progressive diminution has actually taken place seems to be confirmed by a very interesting form of *Papilio cynorta* from Uganda, recently described by Mr. Neave under the name *peculiaris* (Nov. Zool. XI, p. 342, Pl. I, f. 7). According to Dr. Jordan (Trans. Ent. Soc. 1906, p. 219, note) the males are hardly distinguishable from the typical Western *cynorta*. But whereas the female of that form mimics *Planema gea*, and has a conspicuous brown triangle, *peculiaris* mimics *Pl. paragea*, in which the basal triangle is almost obsolete. As a result we find that in the *Papilio* the triangle has been reduced to very small dimensions, all the stripes have disappeared

from it and only the round spot above the cell is left. Here, at least, it is clear that, so far as concerns the brown patch, it is not the *Papilio* which has influenced the *Planema*, but *vice versa*.

A final point may be noticed. On the West Coast the genus *Planema* attains its greatest development and the *echeria* type of *Amauris* is absent; the mimetic *zenobia* Papilios therefore all mimic *Planema*. In East and South Africa where *A. echeria* and *albimaculata* occur with *Planema*, the Papilios have abandoned the latter and mimic the *Amauris*; the reason being, no doubt, that the *Amauris* are much less particular as to the stations which they frequent and are to be found commonly flying right in the shady forests where the Papilios live. The facts appear to fully support Mr. Trimen's view that with these Papilios the earlier tendency was to mimic *Planema* and that they have later been diverted towards *Amauris* (*cf.* Trans. Ent. Soc. 1902, p. 488).

VI. *The suggested diaposematic resemblance between the two Eastern Pierines* Huphina corva *and* Ixias baliensis, ♀.

This suggestion was made by Dr. Dixey in a short paper in Trans. Ent. Soc. 1906 (p. 521, Pl. XXXI). He there calls attention to the fact that *H. nerissa corva* differs from the typical *nerissa* of Continental India in the greater width of the black border on the hind-wings. This it is suggested is a mimetic approach towards the ♀ of *Ixias baliensis*, which is only a slight local modification of *I. reinwardtii*. But so far as concerns the fore-wings, *I. baliensis* has departed from the normal colouring of ♀ *Ixias* by the development of a row of four whitish submarginal spots in the apical black area. In this case it is claimed that the *Ixias* has mimicked the *Huphina*, so that there has been a reciprocal mimetic interchange.

This interpretation involves the assumption of unpalatability in both the species. My friends, Colonel C. T. Bingham, Colonel N. Manders and Mr. R. Shelford, who are all acquainted with both genera in the field, inform me that while the Huphinas certainly exhibit a slow flight and a general demeanour which would suggest the possession of unpleasant qualities, such is by no means the case with the species of *Ixias*, which are active and wary insects. This fact, taken in conjunction with the obviously procryptic

under-side colouring which prevails in that section of the genus to which *I. baliensis* belongs, renders it very improbable that the *Ixias* has in any way influenced the *Huphina*. Furthermore, so far as the ♀ sex is concerned, the increase of the black border in the hind-wing of *H. nerissa corva* is not particularly striking, and there are two females in the British Museum which in this respect are scarcely to be distinguished from a ♀ *nerissa* from Sikkim. It is in the ♂ that the increase is specially noticeable, and this sex can certainly not be reasonably regarded as a mimic of *I. baliensis* ♀, for the entire absence of the heavy black bar across the cell of the fore-wing gives it a very different appearance.

Another serious difficulty, to which Dr. Dixey has himself referred, is the discrepancy in the geographical range of the two species. To meet this it is suggested that either *H. corva* has extended its range, or *I. baliensis* has contracted its range, subsequently to the production of the mimicry. The facts do not appear to justify either of these assumptions. Dealing first with the *Huphina*, we find that the continental form *nerissa* (with its var. *phryne*) is represented in the Andamans by a slightly darker form, *lichenosa*, leading up to the broad-bordered race *corva* (including the scarcely separable *sumatrana*) which is found throughout Sumatra, Java and up to the islands of Bali and Lombok. On the other hand, so far as we know at present, the range of *Ixias reinwardtii* lies entirely to the east of this, namely, in the islands of Timor, Flores, Sumba, Sumbawa, Lombok, up to Bali, which constitutes its westernmost limit.

If we assume *H. corva* to be a mimetic modification of *nerissa* which was evolved in the island of Bali and has since extended thence, we must suppose that originally typical *nerissa* occurred throughout Sumatra, Java and Bali. If this were so, why should *corva* have so totally replaced *nerissa* in Java and Sumatra, where *Ixias baliensis* does not occur, and how are we to explain the existence of an intermediate form in the Andamans? On the other hand, there is even more difficulty in accepting the supposition that *I. reinwardtii baliensis*, which is confined to a little island some 80 by 50 miles in extent, should have originally ranged throughout Java and Sumatra (with a combined length of some 1,700 miles), from which it has now completely disappeared. For the

slight characteristics which distinguish *baliensis* from the typical race *reinwardtii* are essentially such as we should expect to find in a group of individuals which have been comparatively recently isolated from the main body of the species; in other words, *baliensis* differs from *reinwardtii* simply because it has been confined to the island of Bali.

If we examine such a series of forms as *Huphina phryne*, *nerissa*, *lichenosa* and *corva*, it seems clear that we are dealing with those progressive modifications which are generally comprised under the name of geographical races; that is to say, the differences exhibited are accepted as due to the influence of either climatic causes, or isolation, or a combination of both. It is the more probable that such is here the case when we find that the allied Indian *H. nadina* ♂ presents similar modifications; being represented by an intermediate form, *andamana*, in the Andamans, and a more heavily-bordered form, *fawcetti*, in Sumatra. Such progressive widening of the black borders may also be observed in other Pierine genera, such as *Delias*, *Prioneris*, *Appias*, etc.; while from Africa, and doubtless from many other parts of the world, numerous parallel cases could be cited in which no mimetic interpretation could cover the facts.

Further, it may be mentioned that heavy black borders are a very common feature in the genus *Huphina* and exist in a majority of the species occurring in the Malay Archipelago. They attain their highest development in *affinis* (Celebes), in which they occupy nearly half the wing and are far broader than anything to be found throughout the whole genus *Ixias*. A considerable number of species from these islands could be mentioned in which the borders are markedly better developed than in *H. corva*.

I find myself unable therefore to accept the suggestion that the broader black margin of *H. corva* is due to the direct mimetic influence of *I. baliensis* ♀. It is possible that the *Ixias* may have mimicked the *Huphina*, but in dealing with such black and white Pierines a hasty assumption of mimicry is specially to be deprecated; and it is well to bear in mind the judicious warning in this connection uttered by Wallace forty years ago: "By far the most general type of colouring in the Pieridæ, and which recurs in hundreds of species, is a white ground with a black outer border, always most developed at the

apex of the upper-wings, and very frequently less marked on the hind-wings. It is not therefore surprising that among the many slight modifications of this commonest and most simple type of coloration, two species belonging to different genera should closely resemble each other externally" (Trans. Ent. Soc. 1867, p. 311).

Finally, it may be mentioned that very little is known about the ♀ of *I. baliensis*. This sex was not known to Frühstorffer when he described the subspecies in 1897. There is a single specimen at Oxford, namely, that captured by Mr. Shelford and figured by Dr. Dixey (*l. c.*), and only one in the British Museum. The latter differs considerably in appearance from the Oxford ♀, in that it has a pronounced suffusion of yellow in the fore-wing and a reduction of the black markings; it can in no sense be regarded as a mimic of *H. corva*. There is no evidence available as to the relative occurrence of these two forms.

VII. *The suggested reciprocal mimicry between* Papilio dardanus ♀ *form* cenea *and the Danaines* Amauris echeria *and* albimaculata.

The remarkable suggestion that these two dominant species of *Amauris* have been modified in mimicry of *P. dardanus* was propounded by Professor Poulton in Trans. Ent. Soc. 1906, p. 292, and the following comments will be better understood if reference be made to the numerous plates with which his paper is illustrated.

On examining some of the more primitive females of *P. dardanus* (such as *trimeni*, *l. c.* Pl. XVIII, fig. 1), Professor Poulton was struck by the outward production of the basal pale patch of the hind-wing between veins 5 and 6, a character which is readily recognisable in the non-mimetic ♂. Now, in *Amauris echeria* and *albimaculata* the discal pale patch also shows a very marked external angulation at about the same position; but it is contended that this form of marking cannot have been acquired from the *Amauris* by the *Papilio*, because it is ancestral in the latter species. The conclusion is therefore reached that the *Amauris* must have acquired it by mimicking the *Papilio*, and subsequently exaggerated the character. The possibility of independent origin is not considered.

This suggestion invites criticism along three lines: the question of the edibility of the *Papilio*; the relative

numbers of model and mimic; and an examination of the occurrence of the angular markings in the species allied to the *Amauris* and *Papilio* respectively.

With regard to the inedibility of *dardanus*, unfortunately no experiments have been made with this species,* although Mr. Mansel Weale has observed the ♂ to be captured and eaten by a flycatcher (*Terpsiphone perspicillata*) in Cape Colony (Proc. Ent. Soc. 1874, p. 132). But my own observations of the general habits of the species in its natural haunts cannot permit me to regard it as an unpalatable insect, as I should apply that term to an *Acræa*, *Mylothris* or *Neptis*; and that very accurate observer, Mr. R. Trimen, F.R.S., informs me that he is strongly of the same opinion. He was particularly impressed by the fact that the ♀ shows a persistent habit of concealing itself beneath the herbage when not actually searching for food; a habit also noted by the late Colonel Bowker and Mr. Mansel Weale. This behaviour is in striking contrast to that of all S. African species having undoubted nauseous qualities. Again, no one who has seen the ♂ *dardanus* at rest can doubt the cryptic value of its under-side colouring, and Mr. Trimen has quoted an observation of the late Mrs. Barber showing the care exercised in selecting a suitable resting-place (S. Afr. Butt.; iii, p. 254),† another habit which is quite at variance with the assumption of inedibility. Finally, when we examine the more primitive and non-mimetic females of the Abyssinian *P. antinorii* and the Madagascan *P. meriones*, from which *dardanus* is derived, we find that their under-sides are also thoroughly cryptic in character. Thus the balance of evidence certainly appears to be against the supposition

* Drs. Dixey and Longstaff record that the ♂ had a similar smell to that found in *P. demodocus* and described as "like fusty packing-straw," but in *dardanus* it was "less musty." The ♀ was not investigated, so that it is not certain that this odour may not be merely sexual in character, like the musky odour of male hawk-moths mentioned by Darwin ("Descent of Man," p. 308). It may be noted however that a ♂ *Pap. leonidas* examined by Dr. Dixey was considered to have the unpleasant smell of *D. chrysippus*; whereas several males smelt by Dr. Longstaff were found to give a "strong, sweet, 'white flower' scent, followed by something more spicy." A similar discrepancy occurs in their records as to *Neptis agatha* (Proc. Ent. Soc. 1906, p. v). The exact significance of the observations therefore remains doubtful.

† A similar observation has been made by Surgeon-Major Clements at Sierra Leone (*cf.* Proc. Ent. Soc. 1906, p. xxix).

that *dardanus* possesses nauseous qualities; and if this be so, the argument for Diaposematism falls to the ground.

It is not always easy to form a definite conclusion as to the relative numbers of a model and its mimic, but there can be little chance of error in the present instance. We may first note that if the ♀ *dardanus* exhibits this angular marking in such of its forms as *hippocoonoides* or *trophonius*, this can have no mimetic influence upon *A. echeria*, because those forms do not at all resemble this species, but mimic two other Danaines. For this reason we must only consider the occurrence of this angulation in the *cenea* form which mimics *echeria*. We shall find however that that character occurs more rarely in *cenea* than in the above forms, and then nearly always in the examples which are least like *echeria*. Therefore in estimating numbers, we have on one side a comparatively rare variation of a single form of only one sex of the Papilio, and on the other side both sexes of two very common species of *Amauris*. From what I know of the prevalence of these two insects in nature it would be a conservative estimate to reckon that the latter would exceed the former in the ratio of 100 to 1. It has already been shown how impossible it is to believe that in such circumstances the mere operation of the Müllerian factor could have compelled the *Amauris* to mimic this variation of the *Papilio*. Here again the facts appear to entirely forbid a diaposematic interpretation.

When we investigate the occurrence of this angular marking in other species of *Amauris* and *Papilio*, still further difficulties present themselves. With one or two exceptions all the species of *Amauris* have a large basal or sub-basal pale patch on the hind-wings. Out of 20 of such species I find that no less than 13 possess the angulation in question. In *psyttalea* and *dominicanus* it is variable in its occurrence; in such forms as *lobengula* and *crawshayi* it is very similar to what we find in *Pap. dardanus*; in *ochleides*, *hyalites*, etc., it is more marked; whilst in *echeria* and *albimaculata* it is far more developed than in any *Papilio*. On the other hand, this character is a very unusual one in the genus *Papilio*; indeed I have failed to find anything which is really comparable with the *Amauris* pattern except among those Papilios which tend to mimic Danaines in which it already exists. These facts, again, are quite at variance with what

we should expect to find if the argument for reciprocal influence were sound.

It is by no means evident that this angular marking has any real mimetic significance at all. In the more primitive and non-mimetic ♀♀ of *Pap. meriones* and *antinorii* the hind-wing is usually pale yellow, with three large, disconnected, submarginal black patches. The first step in the mimetic approach towards the Danaines appears to have consisted in the linking up of these patches to form the continuous dark border so characteristic of the models. An examination of the various forms of the ♂ *dardanus* shows that the costal and median black patches usually unite in a very characteristic manner, so as to give rise to the angulation in question; and we may reasonably assume that a somewhat similar process took place in the females. Now, it will be found that the development of the angle is fairly constantly correlated with a comparatively narrow black border, and therefore it occurs most frequently in the more primitive and less specialised mimics, such as the forms *trimeni* and *hippocoonoides*, in which the border is not broad. On the other hand, as the inner edge of the border tends to approach the apex of the discoidal cell, so does the angle become more or less completely obliterated. In *Amauris echeria* and *albimaculata* the black border is very broad, and it will be found that the specimens of *P. dardanus* f. *cenea* which present the closest resemblance to them are those in which the border is very broad and the angle consequently obliterated (cf. Trans. Ent. Soc. 1906, Pl. XVII, figs. 8–10, as against fig. 11, which is a comparatively poor mimic).

So far therefore from being able to accept the suggestion that the angular marking has been produced in the *Amauris* by the influence of the *Papilio*, it appears to me that this merely transitional character in the *Papilio* has had so little mimetic value that it is actually in process of being eliminated by the influence of the *Amauris*.*

* It is interesting to note in this connection that neither *Papilio echerioides* nor *P. jacksoni* has developed this angulation, although they are excellent mimics of the same two species of *Amauris*.

VIII. *The mimetic relationship between the Danaine* Melinda formosa *and* Papilio rex.

This point has been discussed by Mr. S. A. Neave in Trans. Ent. Soc. 1906, p. 216 (*cf.* Pl. XI and XII), where he advances the proposition that *Pap. rex* and its local race, *mimeticus*, are not Batesian mimics of *Melinda formosa* and *mercedonia* respectively, but that they are themselves unpalatable insects, which have in some respects mimicked the Danaines, in others served as models for them.

There is no tangible evidence as to the existence of nauseous qualities in these Papilios; it is merely deduced from the supposed reciprocal nature of the mimicry. According to our present knowledge these are very much rarer than the Melindas; indeed, in the case of *mimeticus*, I am not aware of the existence of any specimens beyond the unique type from Uganda, although its suggested mimic is stated by Mr. Neave to be common in that district, and is also recorded from a good many localities in German East Africa.

The foundation of Mr. Neave's argument consists in the assumption that the three species of the African group, or sub-genus, *Melinda*, have been directly derived from *Tirumala petiverana*, which is the African representative of the two common Asiatic species *T. limniace* and *septentrionis*.

Now, the Melindas differ from *petiverana* in having the fore-wings considerably more elongated, and also in having the pale markings at the base of the hind-wing more consolidated, so as to form a continuous pale area, interrupted only by the darkened nervures. These are therefore stated to be "new developments and non-ancestral characters" which have been acquired by the Danaines from *Papilio rex*.

But the validity of this suggested genealogy seems open to serious doubt. The fact that *T. petiverana* represents merely a recent modification of some Eastern *Tirumala* is so clear that it is generally treated as only a local race of *T. limniace*. On the other hand, the Melindas differ from the true Tirumalas not only in the structure of the ♂ brand (upon which Moore founded his genus), but also in several characters in the ♂ genitalia, as well as their general facies. There is no species of *Melinda* in Asia, and these differences appear to indicate that the African forms have been isolated

for a very considerable time from the Eastern Tirumalas. We have therefore no reason for assuming that the obviously recent intruder, *T. petiverana*, must have been the direct progenitor of the Melindas.

The more recent intrusion of *petiverana* must also be inferred if we apply Professor Poulton's test, namely, a comparison of the mimetic effect produced by the respective forms. In spite of its abundance and widespread occurrence in Tropical Africa *petiverana* has not yet succeeded in producing a really close mimic, though there are two or three species which present a generalised resemblance to it; whereas all three Melindas have entered into a very close mimetic association with some particular species, thus indicating that they have been resident in the country for a longer period.

There seems to be no justification for assuming that *Melinda* has been directly derived from any particular species of Asiatic *Tirumala* as we now know it. But with regard to the pale patch in the hind-wing referred to by Mr. Neave, we may note that it occurs in several Eastern Tirumalas, such as various forms of *limniace* and *melissa*, *choaspes*, etc.; its appearance being very similar to what we find in *M. formosa*. Wherefore the statement that this character must be a "new and non-ancestral development" in the last species cannot be reasonably maintained. Moreover, this type of marking is very common among Asiatic Danaines and is particularly characteristic of the African forms.

As to the pointed fore-wing of *M. formosa*, it is true that no *Tirumala* exhibits a similar shape; but this again is far from being an unusual character among Eastern Danaines, and in the genus *Nasuma* it has attained an even greater development than in *Melinda*. An elongated fore-wing is also a very common feature among the African species and is to be found in a considerable number of *Amauris*. It is by no means clear why these slow-flying butterflies should have so largely adopted this pointed form of wing; but it seems not improbable that the cause which has produced this effect in *Amauris* has also operated on the Melindas during their prolonged isolation from their Eastern progenitors. This view is indirectly supported by the following facts.

Mr. Neave has pointed out that in the Abyssinian subspecies *M. formosa neumanni* the fore-wings are slightly

shorter than in the typical form. This is exactly paralleled in the Abyssinian *Amauris hecate stictica*, which has the fore-wing very distinctly shorter than in the Western *hecate*; and again examples of *A. echeria streckeri* from the same locality have these wings appreciably less pointed than in *A. echeria jacksoni* from British East Africa. Neither can there be any question as to mimetic influence between these three very different species. We are therefore justified in assuming provisionally that the shape of the wing is affected by some general local factor.*

It has been suggested by Mr. Neave that *M. formosa neumanni* represents an intermediate stage between *M. formosa* and *T. petiverana*; but he then had only a single example of *neumanni* at his disposal. Dr. Jordan has very kindly brought up to London for my examination three typical specimens of this Abyssinian form, and he entirely agrees with me that there are no adequate reasons for accepting this suggestion, the improbability of which has already been shown on other grounds.

The attempt to interpret the mimicry in this case as being reciprocal does not appear convincing, while the facts are entirely consonant with the conception that the *Papilio* is a simple Batesian mimic of the *Melinda*. *P. rex* is a very isolated species and has evidently been profoundly modified by mimetic influences. But its structural characters, in conjunction with the characteristic arrangement of the submarginal row of yellow spots, indicate that its nearest ally is *P. demodocus*, which has the fore-wings much less produced. It is probable therefore that *rex* represents a mimetic modification of some *demodocus*-like ancestor.

My friend Mr. Trimen has kindly permitted me to quote the following comments which he has sent me in connection with this case: "The latter feature [elongation of fore-wing] strikes me as affording extremely weak support to that theory [reciprocal mimicry], seeing that, next to the showy and strongly-contrasted colours on both upper and under surfaces of the wings, there is no feature so

* Wallace has recorded ("Malay Archip." p. 215) that there is a similar tendency in the Island of Celebes for butterflies of different genera and subfamilies to develop a markedly pointed or elongated wing. It may be noted that *Amauris comorana*, in the Comoro Islands, has a sharper fore-wing than any continental species, being in this respect very similar to *M. formosa*.

universally and saliently denoting the unpalatable groups of butterflies. It is impossible to doubt that in all these groups the advantage of the prolongation of the fore-wings is primarily to increase conspicuousness by that special form of wing, and secondly to increase the area available for warning colours. The character being so general and so fixed in tendency, one cannot be surprised to find some species developing it more than others; and there seems no need, in such a case as that of the *Melinda* Danaines, to have recourse to the far-fetched idea of these abundant and distasteful butterflies having to borrow so natural a feature from the rare *Papilio rex* and extremely rare *P. mimeticus*. In the genus *Acræa* no one deems it necessary to account for such great prolongation of the fore-wing as is found in *A. perenna* or *A. pharsalus* by assigning it to mimicry of any butterfly of a remote family."

These then are the cases which have so far been adduced to demonstrate the actual occurrence in nature of Reciprocal Mimicry. To my mind, the facts when critically examined do not lend any valid support to such a hypothesis; nor even do they appear to justify in any instance the assumption of that mimetic inter-action which I have termed Alternating Mimicry or Resemblance.

The Scope of Batesian Mimicry.

Up to the present time it has generally been considered that mimicry between two species which both possess distasteful qualities cannot possibly be explained on the lines of Bates' theory, but that the association must be Müllerian in character; in other words, that it can only have been produced by the selective action of experimental tasting by inexperienced animals. Now when I began experimenting on these subjects in South Africa, some twelve years ago, one of the first things that impressed me was the fact that there was clearly a considerable difference in the degrees of distastefulness, not only between different genera of butterflies, but even within the limits of a single genus, such as *Acræa*. Further, the question was complicated by the divergence in the likes and dislikes of various insectivorous animals. No doubt all this has long been recognised; yet in practice, the application of the Müllerian interpretation involves the assumption of a uniform standard

of inedibility, and the complications which would be introduced by inequality in this respect have not been taken into account.

When we recognise however that there actually are varying grades of unpalatability in butterflies, and that certain enemies may adapt themselves to prey on the less protected forms while avoiding those that are most nauseous, it becomes clear that any mimicry which may arise as a result of such selection could not possibly be classed as Müllerian, but would be due to the simple operation of the principle enunciated by Bates, in spite of the fact that the mimic possesses qualities rendering it distasteful to other animals. That there is no inherent improbability in such a supposition is shown by some experiments I made upon a tame ground hornbill (*Bucorax caffer*) in Natal (Trans. Ent. Soc. 1904, p. 347). To this bird, which roamed unconfined, I gave at different times five species of *Acræa* and one of *Planema*, all of which were readily eaten and with evident appreciation; but when a *Danaida chrysippus* was offered to it, it merely crushed the thorax and dropped it at once, a second specimen being treated in a precisely similar manner. Again, through the kindness of Mr. C. F. M. Swynnerton I have obtained proof that wild Bee-eaters will prey upon Acræas; there is also some evidence that they avoid Danaines. When fuller information is obtained on this point it may be necessary to reconsider the current supposition that the mimicry of *Acræa encedon* for *Danaida chrysippus* is purely Müllerian.

But there is another way in which Batesian mimicry may have arisen among unpalatable butterflies. Professor Poulton long ago pointed out that insectivorous animals which, under normal conditions, would refuse insects having an unpleasant taste, would yet eat them when driven thereto by hunger. If we suppose that in such circumstances a wild bird were compelled to feed upon distasteful insects, upon making experiments it would doubtless find that while some of these were extremely unpleasant, others would be passable. It seems an entirely fair and reasonable supposition to infer that this bird would select the species which were less unpalatable to the exclusion of the others, and if the necessary variations arose, this selection would tend to cause the former to become Batesian mimics of the latter. Such

conditions would be likely to occur very frequently during the dry winter months in South Africa. Here again I find some confirmatory evidence among my experiments (Trans. Ent. Soc. 1902, p. 344). A tame kestrel (*Tinnunculus naumanni*), which had shown pronounced dislike of both Acræas and *Danaida chrysippus*, was starved for twenty-four hours. After eating seven palatable butterflies it was given two Acræas, which were swallowed whole; then a *D. chrysippus* was offered to it, which was tasted but emphatically rejected, and immediately afterwards three more Acræas were swallowed whole. Thus under the stress of hunger the bitter juices of the Acræas were disregarded, but the more highly unpleasant flavour of the Danaine still remained a deterrent.

From these remarks we see that the interpretation of Batesian mimicry is not to be restricted only to those cases where an edible species mimics an inedible model; but while in Müllerian mimicry the essential condition is a difference in the individual numbers of two inedible species, in Batesian mimicry the essential condition is a difference in the palatability. Both species may be distasteful, but wherever there is scope for preference, there it is possible for Bates' principle to operate. Thus, so far from being able to accept the suggestion that practically all mimicry among butterflies is Müllerian in character, it seems to me that we have not yet begun to appreciate how wide a significance Bates' principle may have. The question is extremely complex, and resolves itself ultimately into a consideration of the mental attitude of insectivorous animals towards their prey. It is even possible for a single species to be at the same time both a Müllerian and a Batesian mimic of one and the same species in relation to the attacks of different enemies. The final decision on these points must rest with the field-observer and experimenter.

On the greater predominance of the factors which make for Batesian mimicry.

There are some general considerations which also appear to negative the supposition that the occurrence of Müllerian mimicry is far in excess of Batesian. It has already been argued (p. 113) that the operation of the Müllerian factor is practically restricted to the breeding season of birds,

etc., while Bates' factor is in force at all times. But if we further consider the life of an individual bird it is apparent that its experimental period is only of short duration, while for the rest of its life its selective action will be simply in a Batesian sense; its increasing experience giving it added efficacy in this direction. As against this view Professor Poulton has urged (Proc. Ent. Soc. 1903, p. ix) that Müllerian selection is probably more keen than it appears; that we must not estimate it by a comparison of the relative numbers of mature and immature enemies at any given time, but that we must remember that there is a considerable elimination of the young of these enemies, so that a large percentage never reaches maturity, and it is apparently assumed that these individuals only operate as Müllerian factors.

Taking the case of birds, which are, almost certainly, the principal agents in the production of mimicry among butterflies, let us examine this matter of the destruction of the young. We have no exact knowledge on the subject at all, but it is reasonable to suppose that the most critical and dangerous period of a young bird's life is during the time when it is a helpless nestling and also for a few days after it has left the nest, while it is still unable to fly properly, to recognise its enemies or to provide itself with food. It is probable, therefore, that by far the greatest destruction of life among young birds will take place between the time when they leave the egg and the time when they are able to fly properly and forage for themselves. But throughout this period young birds do *not* operate as Müllerian factors; such selective influence as they may have upon the insects in their neighbourhood will be exercised entirely through the medium of their parents, and as these latter will be mature and, presumably, experienced birds, their effect will be solely in a Batesian direction. This aspect of the question therefore does not, as it seems to me, add weight to the Müllerian argument, but rather the reverse.

Tenacity of life in unpalatable species.

Many observers have called attention to the fact that various butterflies exhibit a very remarkable tenacity of life, accompanied by a toughness of the integuments. In all these cases the insects belong to genera in which the

existence of nauseous qualities has been well established, and this tenacity does not appear to occur apart from those qualities. The great utility of such a faculty to insects which are liable to be experimentally seized and rejected by enemies is so obvious that its very existence may be taken as good circumstantial evidence that Müller's factor is an objective reality, and not a mere figment of the imagination. But it must not be forgotten that the very efficacy of this characteristic in saving the lives of the insects and enabling them to propagate their kind after experimental attacks (an essential condition for its development) causes it to become a serious check on the production of Müllerian mimicry; for such mimicry can be brought about only by a progressive destruction, or sexual disablement, by experimental tasting, of those individuals of the mimic which do not conform to the mimetic pattern. Wherefore any quality evolved by the species which diminishes this destruction must, so far as it is successful, prevent a mimetic approach. This limitation of Müller's conception does not appear to have been sufficiently taken into account.

Colour as a guide to unpalatability.

Although the existence of displeasing qualities in butterflies is very generally indicated by bright colours on both surfaces of the wings, such is by no means always the case. Among the *Acræinæ*, *Ithomiinæ*, and especially the *Euplœini*, there are many instances of colouring so sombre that were it associated with the requisite procryptic habits it would serve most effectually as a means of concealment. In such instances it is only the slow heavy flight and generally gregarious habits of the insects which cause them to become conspicuous objects; and these peculiarities of manner are to be found in every species whose distastefulness has been satisfactorily demonstrated. On the other hand, there is at present no experimental evidence which clearly proves the existence of inedible qualities in butterflies which exhibit a strong active flight and general wariness of manner, together with obviously procryptic habits. We may of course assume the existence of such qualities, but the value and desirability of such an assumption must remain merely a matter of opinion.

As a result of a good many years' experience of

butterfly life in South Africa I am convinced that we shall obtain a truer insight into the mimetic relationships of these insects if we take their natural behaviour as our guide, than if we rely too exclusively upon theoretical deductions based on colour patterns alone.

To take an example. We know nothing whatever about the edibility, or otherwise, of the numerous species of South American *Erycinidæ*. There appear to be a good many cases of mimicry among them, and a certain number of the species are very brightly coloured. It has therefore been supposed that the family is probably unpalatable as a whole. On the other hand, Wallace tells us (Trans. Ent. Soc. (2), II, 1863, p. 262) that the brightly-coloured species of *Erycina* have a very quick, jerky, "skipper"-like flight; whereas of the other genera "the great mass of the species" have the curious habit of always settling on the under-sides of leaves with wings outspread.* Now habits such as these are not known to occur among any distasteful butterflies in any part of the world; for, as we have seen, leisurely movements and a contempt for concealment are the most essential characteristics of these insects, for which the display of their warning colours is of the very first importance. In the light of our present knowledge therefore it seems difficult to justify such a far-reaching assumption of distastefulness; and we can scarce hope for stability in the theoretical edifices which may be raised on so dubious a foundation.

Again, it has been suggested that the roughly *Acræa*-like facies of the giant *Papilio antimachus* of West Africa has probably a Müllerian significance, apparently without any regard to its habits. My friend, Professor Yngve Sjöstedt, of Stockholm, who collected for some time in the Cameroons, has given me a graphic account of the great wariness and tremendous speed of this strange insect, whose flight, he said, could only be compared to that of a swallow. On the other hand, he told me that the lovely blue *Papilio zalmoxis*, which is often associated with *antimachus* by systematists, was far more common, having a slow heavy flight and being easily captured. In this case the habits serve to confirm the idea of distastefulness suggested by the appearance of the insect. But are we then to

* Bates also gives some interesting notes on the remarkable differences of habits which are to be found in this family (*op. cit.* (2), V, 1858, pp. 4, 5.

put *antimachus* in the same category, and utterly ignore that remarkable divergence in behaviour which of itself bears eloquent testimony to a profound difference between these two species in relation to their insectivorous foes?

The Pierine genus *Belenois* has also been credited with unpleasant qualities, and these are supposed to be so marked that, as recently suggested, *B. severina* has been mimicked by several species of other genera. There is nothing in the flight of this species to lend colour to such a view, and it has apparently been overlooked that in my experiments (Trans. Ent. Soc. 1902, *passim*) this insect and the closely allied *B. mesentina* were eaten by baboons with evident relish. They were also eaten without any signs of distaste by a mongoose, a kestrel and mantises; while Colonel Yerbury observed *B. mesentina* to be eaten in large numbers by spiders, and its larvæ were eagerly devoured by my baboon. The assumption of a pronounced degree of distastefulness in this case does not seem to be warranted, unless supported by experiments which shall refute the results obtained by myself.

The suggestion of inedibility in the genus *Precis* is still more instructive, and may therefore be treated more in detail.

The suggested distastefulness of the Nymphaline genus Precis.

In Trans. Ent. Soc. 1902 (pp. 424–430) Professor Poulton very strongly urged the probable unpalatability of the genus *Precis*, basing his views upon the apparent conspicuousness of the under-side colouring in the wet phases of three species. For he says: "It has here been shown that there are important [warning] elements in the under-side coloration of the wet phases of *Precis sesamus* and *P. antilope* which cannot be explained as mimicry, Batesian or Müllerian, while the entire appearance of the under surface of *P. archesia* f. *pelasgis* can only be interpreted as a warning character" (*l. c.* p. 438). This conception is further supplemented by the "inevitable conclusion" that the conspicuousness of the wet phase has been modified out of the older cryptic appearance of the dry (*l. c.* pp. 430, 431); and the tentative suggestion that the former phase may be more unpalatable than the latter (p. 441).

With regard to the black, white-spotted area at the base of the under-side of the hind-wing in the wet phase of *sesamus* and *antilope*, Professor Poulton has himself recognised that this marking is not so isolated as he at first thought (p. 427). Indeed, it actually occurs in those very Acræas to which these insects present a rough mimetic resemblance, and therefore its appearance in *Precis can* quite consistently be explained on Batesian lines. Thus an important plank in his argument collapses.

Next as to the case of *pelasgis*, Professor Poulton says that "the conspicuous appearance of the under-sides of these forms is doubtless chiefly adapted to render them conspicuous during the attitude of rest" (p. 438). Now unlike Danaines and Acræas, I have found it no easy matter to discover a wet-phase *Precis* in an attitude of prolonged rest, and in every such case that I can recollect the butterfly had concealed itself on the under-surface of a leaf; a position which can hardly be considered to lend itself to a display of warning colours.

During my last summer in Rhodesia I kept a special look-out for *pelasgis*, and on three occasions I observed a specimen going to roost under the broad leaves of its food-plant. I trust some other entomologist will check my observations, for I must confess that I utterly failed to detect in the appearance of these insects anything which could be described, even by the widest stretch of imagination, as "startlingly conspicuous" (p. 429). On the contrary, the general effect of the colouring harmonised with the surroundings in a way one would not expect when merely examining the insect in the cabinet; for the pale transverse stripe (the so-called "warning" band) did not throw the insect into relief, but served only to break up its contour, which thus became less obvious in the lights and shadows among the leaves. I do not wish to maintain, however, that the colour of *pelasgis* is ideally procryptic; far from it. But of this I feel assured, that it would afford adequate protection to an edible species at a time when the struggle for existence is not too keen, and when the shrubs and bushes still retain sufficient leaves beneath which it may safely shelter. Nor can I think that its colouring would prove a danger to so alert and active an insect during its waking hours.

The next point to be considered is the supposition that

the brighter under-side colours of the wet phases of these species has been more recently evolved from the older cryptic pattern of the dry phase. On general grounds such a conclusion seems very difficult to accept. There can be no question that for butterflies which are on the wing throughout the year in South Africa the dry season is the time of greatest stress and danger. And from this it can only be concluded that that phase which alone is able to subsist under such conditions must present a higher degree of protective efficiency, either in colour or habits, than does the wet phase. If then it be supposed that this cryptic coloration, or some modification of it, was originally common to both seasons, it is difficult to understand why it should subsequently have been eliminated for the purpose of establishing a scheme of colouring having a lower protective value. For if this cryptic under-side afforded an efficient protection from the greater risks of the dry season, it must have been amply sufficient to meet the requirements of the species during the less dangerous summer months. A comparison of various details of the patterns also seems to me to point strongly to the opposite conclusion, namely, that the dry phase is a more recent development of the wet in response to a greater need for protection; while in the case of *sesamus*, there is important experimental evidence in the same sense. In these experiments, which are as yet unpublished, I found that by the application of moisture I could convert the dry phase into the wet; but I could not convert the wet into the dry, either by dryness or cold. If we accept Weissman's arguments in respect to *Araschnia levana*, this evidence must be taken as indicating that the wet form is phylogenetically older than the dry. Thus the suggestion that the wet phase represents an unpalatable and warningly-coloured form, which has been evolved from the cryptic dry phase, finds no support. On the contrary, the evidence points to the conclusion that the cryptic dry phase is a later development in response to a greater need for protection, and also shows that there is no adequate reason why we should postulate distastefulness in the wet phase of this genus.

Finally, we may turn to the evidence yielded by the various experiments which are detailed in the earlier pages of the same paper. In the course of these experiments examples of five species of *Precis* (including

Junonia) were offered to mantises, a spider, a kestrel, a ground-hornbill, a mongoose, a monkey (*Cercopithecus pygerythrus*) and baboons; and subsequently (unpublished) to another species of monkey, *Cerc. albigularis*. In no case did the behaviour of these animals give any grounds for the supposition that the butterflies possessed any unpleasant flavour whatsoever; and the value of the evidence is obviously enhanced by the fact that the *Precis* were readily eaten by a number of very different animals. But leaving out of consideration those animals which exhibited rather indiscriminate tastes, we may briefly summarise the remaining cases:—

Precis antilope (dry phase): 2 examples eaten readily by *Cerc. pygerythrus*.

P. archesia (wet): 4 eaten with relish by kestrel; also eaten by wild rock lizards.

P. archesia (dry): 1 eaten by baboon.

P. sesamus (wet): 4 eaten with relish by kestrel; 1 eaten readily by *Cerc. pygerythrus*; 5 eaten by baboons; also eaten by wild rock lizards.

P. sesamus (dry): 2 eaten readily by baboons; 12 eaten on five different occasions by *Cerc. albigularis*, which received the first with some caution, while every subsequent insect was taken with evident appreciation, the monkey cramming them into its mouth wings and all. The same animal refused *Acræa natalica* and two species of *Amauris* with evident signs of disgust.

P. cebrene: 5 eaten with relish by kestrel; 1 eaten readily by *Cerc. pygerythrus*; 1 eaten by wild kingfisher.

The first *P. sesamus* (wet) which was given to a baboon was merely pulled to pieces without being tasted, but the remains were promptly eaten by its companion, and immediately afterwards each baboon ate another specimen. In the light of a subsequent experiment (*l. c.* p. 382), there can be little doubt that this first rejection was due to the misapprehension that the insect was an *Acræa*, to which it presents a general resemblance.

In view of all the foregoing considerations I find it impossible to entertain the idea that the genus *Precis* possesses any appreciable distasteful qualities.

The value of experiment as evidence of palatability.

The divergence of opinion which exists on the subject of palatability between the more extreme and more moderate supporters of Müller's theory practically resolves itself into a question of the relative value and reliability of the various lines of evidence available. The following are the principal sources from which information may be derived, given in the order of their importance.

(1) Exact observation as to the insects actually eaten and avoided by wild insectivorous animals.
(2) Careful experiments upon wild or captive animals.
(3) Field observations on the flight and general habits of insects in relation to their environment.
(4) The comparative study of colour patterns and structure.

The first class of evidence, which is obviously most essential, is unfortunately the most difficult to procure, more especially in the case of butterflies; for very many birds cut off the wings of these insects before eating them, and they cannot therefore be identified by an examination of the stomach contents, as in the case of insects having easily recognisable chitinous structures. Thus we must rely to a very great extent upon the three remaining sources of information.

Now in almost all those cases where the existence of unpalatability is in dispute it will be found that the arguments in its favour are based exclusively upon the fourth line of evidence. But I believe that most entomologists will agree that deductions of this kind are peculiarly liable to error unless they be supported by evidence from some other line of investigation. For my part, where I find that conclusions derived from (2) and (3) point in one direction, and those derived from (4) in another, I have little hesitation in accepting the former and rejecting the latter.

As against this, it will be contended that habits cannot be taken as an absolute proof of edibility or otherwise. For although all the butterflies that have nauseous qualities announce their presence by a characteristic demeanour, yet we must not suppose that these qualities have suddenly appeared as we now see them; on the

contrary, they will have been gradually evolved. We may therefore expect to find at the present day species in a transitional state, which, while possessing a certain degree of distastefulness, still find it necessary to retain the habits, or even the colouring, of edible forms. With this proposition I entirely agree; for it seems very probable that such cases will occasionally be found. But I fail to see that such an admission will justify a wholesale assumption of moderate distastefulness throughout all the *Pierinæ*, for example; and this is especially unwarranted in those particular cases where experimental evidence points in an opposite direction.

Here another objection is likely to be raised against me, for it will be argued that experimental evidence may at times be very misleading. Again I am quite ready to admit that there is much truth in this as a general observation. Professor Poulton insisted very strongly upon this view when commenting upon my experiments (Trans. Ent. Soc. 1902). With reference to the eating of *Acræinæ* by a ground hornbill, he says: "It has already been pointed out that the acceptance of insects by insectivorous animals in captivity is no proof of their normal likes or dislikes in a wild state. Such acceptance only proves what their action would be when they had been, from some exceptional cause, kept without their normal food in its usual quantity and variety" (*l. c.* p. 348). Unfortunately the general criticism does not happen to apply to the particular case. The bird was entirely unconfined, and wandered at will searching for his food just like his wild relatives on the next hill-side, with only this exception: if insects, etc., were scarce, the wild birds would have to go hungry or eat what they did not like, while Colonel Bowker's bird always got additional food at the house. The conditions of the experiment therefore render it highly improbable that the hornbill was eating insects which it would normally reject, and its whole demeanour was quite at variance with such a supposition.

Again, in reference to my experiments with baboons the following criticism was made: "Considering what has been already argued about insect-eating animals in confinement, the acceptances (excluding the *Hesperidæ*) probably do not justify the conclusion that the Lepidoptera were palatable, or that they would be sought for in the wild state except under the stress of hunger" (*l. c.* p. 389).

I very much regret that here likewise I am quite unable to agree to this sweeping rejection of the whole of the evidence that tells in favour of palatability, merely on an *à priori* assumption. In the carrying out of these experiments the importance of maintaining a natural diet was fully recognised, and although there will be no doubt a certain percentage of error, yet I am well satisfied that the results may be taken as giving a very fair idea as to the general likes and dislikes of these animals in regard to both butterflies and Coleoptera. Surely it must be something more than a mere coincidence that in every case where the flight or habits of a butterfly indicated the probable existence of an unpleasant taste, the baboons arrived at a similar conclusion from actual experiment. Moreover it is not quite clear why acceptance should be admitted as evidence of edibility in Coleoptera, but not in Lepidoptera.

Later on in the same paper the question of experimental evidence is summarised in the following terms: "It has already been pointed out that the refusal or evident dislike of insect food by captive animals is trustworthy evidence of unpalatability, while acceptance is not proof of palatability" (*l. c.* p. 436). This statement seems open to serious objection on two grounds. In the first place, there is too emphatic an insistence upon the possibility of error where an insect is accepted; for it practically casts suspicion upon every such case. On the other hand, the possibility of error in the other direction is not indicated. I agree that where an insect is tasted and rejected with signs of dislike, such is good evidence of distastefulness. But where an insect is merely disregarded or refused without tasting, this is not of itself reliable evidence; it may, or may not, indicate the existence of nauseous qualities. Everything depends upon the conditions of the experiment. To take a few examples. The refusal by one of my baboons of the first specimen of *Precis sesamus* (wet) cannot be interpreted as a sign of unpalatability, for this is negatived by their subsequent behaviour towards this species; the refusal was almost certainly due to either a mimetic misapprehension, or that general distrust of brightly coloured insects usually exhibited by these animals. Care also had to be exercised that too many distasteful things were not presented at once, otherwise they became very suspicious of everything offered to them.

The rejection of the first specimen of the scarlet-tipped *Teracolus achine* has likewise no significance, for on several occasions subsequently they ate fourteen similarly coloured specimens of this genus "with undoubted appreciation." Again on offering a larva of *Belenois mesentina* to the female baboon she was clearly afraid of it and tasted it most cautiously, yet on finding it all right she "eagerly devoured over twenty of them" (*l. c.* p. 385). Yet the male, which was far more timid and suspicious in temperament, "was much too frightened to eat them in spite of the example of the female." Had these larvæ been offered to the male only, it is probable that an entirely erroneous conclusion as to their extreme unpalatability would have been deduced from his behaviour. Cases of this kind might be easily multiplied, as, for instance, where unsuitable insects are offered, or where suitable insects are given to over-fed animals, and so forth.

The fact remains that even when reasonable care is exercised there must be many opportunities for error in estimating degrees of palatability or the reverse. Yet it seems a fair contention that, in the absence of obvious mistakes or inaccuracies, the true value of such experimental evidence can best be assessed by the man who actually carries out the experiments. He will be fully cognisant of all the conditions under which the experiments were made; he will presumably be acquainted with the special idiosyncrasies (often a very important point) of those animals upon which he experiments; finally, he alone is able to see and compare those subtle differences of manner, facial expression, etc., which constitute our only guide in estimating the psychological effect produced upon the animal. If similar experiments are repeated by a number of other observers the chances of error will be much diminished, and we shall thus obtain a solid foundation of fact upon which to build up those broad generalisations after which we are seeking.

A final point may be noticed. It has been suggested to me that perhaps we may be unable to demonstrate by experiment these incipient degrees of distastefulness which have been postulated for many genera of *Nymphalinæ* and *Pierinæ*. But if these unpleasant flavours are so slight that insectivorous animals in captivity are unable to appreciate them, it seems scarcely probable that they will have any real selection value, or that they will be

capable of producing the profound colour modifications which have been attributed to them. When an insect having such qualities mimics a really unpalatable species, it seems highly probable that the mimicry will have been due to the operation of Bates' factor and not that of Müller. For we must remember that birds have probably been the principal agents in producing these effects, and Professor Poulton has himself arrived at the conclusion that the discriminative tastes of birds are not as highly developed as those of mammals (Rep. Brit. Ass. 1887, p. 764). As he there says, this is what we should rather expect owing to the relative difference in their intelligence; and it is not therefore likely that a slightly unpleasant taste in a butterfly will have a mimetic importance in relation to birds, when it apparently remains undetected by so intelligent an animal as a baboon.

In conclusion, I must express the sincere regret I feel at having to insist so much upon the points in which I differ from my old friends Professor Poulton and Dr. Dixey, to whom I am so deeply indebted, not only for their continued personal kindness and encouragement, but also for the stimulating influence of their many valuable publications, with the general tenor of which I am entirely in accord. For although I have thought it necessary to point out what I consider to be definite limitations to Fritz Müller's principle, I have yet a firm belief in its reality as an objective factor which has profoundly influenced a large number of insects in the tropics. But I am likewise impressed with the equal importance of Bates' principle. I have at least the consolation of finding that my friend Mr. Roland Trimen is in close agreement with the views here advocated, and I have to offer him my grateful thanks for kindly checking the greater part of my manuscript, and for the valuable comments he has made thereon.

I can only hope that this discussion may serve to stimulate other naturalists in the tropics to undertake those experiments and observations which are so much needed for the furtherance of this fascinating line of research.

VIII. *Descriptions of New Species of* Lepidoptera-Heterocera *from South-east Brazil.* By E. Dukinfield Jones, F.E.S.

[Read March 4th, 1908.]

Note.—The species described in the following paper were for the most part taken by myself, and the types remain in my own private collection.

E. Dukinfield Jones.

Castro, Reigate, 1908.

Family SYNTOMIDÆ.

Pheia hæmatostieta, n. sp.

♀. Palpi fuscous black, a few white scales on 1st and 2nd joints; head and body fuscous black, antennæ white on under-side near extremity, extremity black; two large white spots on pectus; fore coxæ black with large white spot and a few white scales at extremity; middle and hind coxæ white; legs black; abdomen ventrally white on first 3 segments; a pair of crimson spots on tegulæ and on shoulders. Fore-wings hyaline rather heavily bordered with black especially on termen, the black running about half way up vein 2, very broad at apex; veins black and rather broad; a broad discocellular bar; a crimson spot at base between median and submedian: hind-wings narrowly bordered with black on inner margin, broadening on termen to apex; costa grey.

Expanse 31 mm.

Hab. Castro, Paraná.

Loxophlebia aurantiaca, n. sp.

♂. Palpi head and antennæ black; coxæ white; tegulæ thorax and abdomen bright orange; a black dorsal line on thorax and first two segments of abdomen; last three segments black; valve creamy-white. Fore-wings hyaline narrowly bordered with fuscous black on costa termen and inner margin, broadly at apex; base orange; a rather slight discocellular bar; a black fascia on cellular fold at terminal area. Hind-wings narrowly bordered with black rather broader at apex and on inner margin; base orange.

Expanse 23 mm.

Hab. S. E. Brazil.

Loxophlebia flavinigra, n. sp.

♂. Palpi inwardly dull yellow, outwardly black, 3rd joint black; head thorax and abdomen dull yellow; legs yellow and black; pectus yellow; vertex centrally black, a minute black dot behind the antennæ; tegula posteriorly black; a broad black stripe on patagia; a broad black dorsal line on thorax and abdomen; anal tuft black with subdorsal yellow streaks; terminal 3 segments ventrally black, the black extending sublaterally to segment 4. Fore-wings hyaline, narrowly bordered with black broadening slightly at vein 2 and moderately broad at apex; a broad black discocellular bar; base yellow followed by fringe of black, subcostal irrorated with yellow to beyond middle of cell: hind-wings hyaline narrowly bordered with black, broader on inner margin and very narrow on costa, moderately broad at apex; base yellow.

Expanse ♂ 22 mm., ♀ 21 mm.

Hab. Castro, Paraná.

Holophæa lugens, n. sp.

♂. Fuscous black; fore coxæ inwardly white; hind tarsi with the end of the 1st joint and the whole of the other joints white on upper-side.

♀. Differs from ♂ in having no white on coxæ.

Expanse ♂ 28 mm., ♀ 32 mm.

Hab. São Paulo, S.E. Brazil.

Horama castrensis, n. sp.

♂. Black slightly suffused with metallic-green. Tegulæ with two white spots on each; abdomen two white spots on 1st segment, large white lateral spots on 2nd and 3rd segments; ventral white spot on third segment; three lateral white spots on under-side of thorax. Fore-wings dull black; a white point at base of costa.

Expanse 30 mm.

Hab. Castro, Paraná.

Horama flavata, n. sp.

♂. Palpi orange, a black spot on 2nd joint; antennæ black; head black and orange, a yellow spot between the antennæ; tegulæ greenish-black with white edges laterally and centrally; patagia black with reddish-brown stripe, yellow in front; mesothorax black with four buff spots; abdomen greenish-black, the segments indistinctively brown posteriorly; 1st segment with two white

dorsal and large orange lateral spots; large white lateral spots on segments 2 and 3 and orange on the rest. Under-side of thorax orange and black with three large white lateral spots; legs black and orange; hind tibiæ black with orange patch, tarsi orange. Fore-wings greenish-black suffused with orange; one white and two orange dots at base. Hind-wings orange broadly suffused with black at apex and termen. Under-side: fore-wings suffused with orange; hind-wings rather more suffused with black than upper-side.

Expanse 30 mm.

Hab. CASTRO, Paraná.

Delphyre subapicalis, n. sp.

♀. Smoky-black; palpi 1st joint orange, 2nd black and orange, 3rd black; head and pectus orange; antennæ black; tegulæ smoky-black tinged with orange; patagia bordered by light brown with smoky fringe; under-side of abdomen creamy-white. Fore-wings smoky-black, the veins a lighter shade; a large white spot near apex extending from near costa to below vein 4. Hind-wings black, centrally semihyaline.

Expanse 39 mm.

Hab. CASTRO, Paraná.

Family ARCTIADÆ.

Sub-family *LITHOSIANÆ*.

Odozana cocciniceps, n. sp.

♀. Head bright rose-pink; a dark spot on vertex; antennæ black; tegulæ rose-pink in front, black behind; thorax abdomen and legs smoky-black. Fore-wings smoky-black; hind-wings bright rose-pink heavily bordered with black.

Expanse 20 mm.

Hab. CASTRO, Paraná.

Odozana endoxantha, n. sp.

♂. Palpi black with yellow hairs at base; head thorax and abdomen dull yellow; frons black; front legs black; mid coxæ yellow, femora tibiæ and tarsi black; hind-legs yellow, tarsi suffused with black. Fore-wings smoky-brown, a broad yellow fascia on inner margin from base to near tornus; a large yellow spot on costa

at end of cell. Hind-wings yellow narrowly bordered with black on termen, broadly at apex. Under-side: fore-wings, the yellow spot on costa coalesces with the fascia or inner margin; hind-wings the same as upper-side.

Expanse 22 mm.

Hab. Castro, Paraná.

Thyone trimaculata, n. sp.

♂. White. Fore and mid femora white; tibiæ and tarsi thickly scaled with smoky-black; hind legs entirely white. Fore-wings, a black spot on vein 1 one-third from base, a second spot near tornus; a third black spot beyond cell on vein 5; a few black scales making a minute dot on subcostal at base of vein 11; a minute black dot on vein 10 sometimes present.

Expanse 25 mm.

Hab. Castro, Paraná.

Clemensia acropera, n. sp.

♂. Palpi light brown; head and antennæ ochreous-brown; thorax brown; abdomen ochreous. Fore-wings ochreous heavily suffused with brown at base costa and apex, where the suffusion is very wide, diminishing to a point at tornus; four interrupted wavy brown transverse lines. Hind-wings ochreous-white; cilia tinged with brown.

Expanse 19 mm.

Hab. Castro, Paraná.

Sub-family *ARCTIANÆ*.

Automolis neritosia, n. sp.

♂. Palpi rose-pink, 3rd joint ochreous; head and antennæ light brown. Legs ochreous, the front pair rosy on upper-side; thorax light brown, tinged with rose-pink, creamy-white beneath; abdomen bright rose-pink above, creamy-white beneath. Fore-wings light brown from base to an irregular line from tornus to middle of subcostal, a darker shade on inner-side of line; the rest of the wing ochreous with the exception of a triangular brown space at apex; base tinged with rose on inner margin. Hind-wings ochreous suffused with rose-pink.

Expanse 29 mm.

Hab. Castro, Paraná.

Opharus albimacula, n. sp.

♂. Palpi fuscous, an orange spot on 1st and 2nd joints; head and thorax fuscous with orange spots; a large white spot in the centre of each tegula, and end of each patagium; coxæ and extremities of spurs orange; abdomen orange, dorsally fuscous from base to 5th segment, ventrally fuscous with sub-lateral series of orange spots. Fore-wings white, the veins black; the series of orange spots placed on clearly defined black bands; a large black spot on medial area from costa to median vein containing orange spot in upper half of cell (sometimes in lower half also) and a smaller spot on sub-median fold; a black streak along sub-median fold, a basal orange spot and two sub-basal above and below cell; an antemedial series of spots incurved from vein 1 to below cell where it is angled, then oblique to costa; a postmedial series incurved from inner-margin to vein 3, then excurved to costa; a sub-terminal series bent outwards at vein 7; a terminal series on the veins. Hind-wings whitish heavily suffused with fuscous, veins fuscous; minute orange spots at ends of veins, the amount of suffusion very variable, often almost obliterating all white.

Expanse ♂ 44 mm., ♀ 49 mm.

Hab. Castro, Paraná.

Very near *O. schæfferi* H-S, but differs from it in the black bands on the fore-wings being darker and clearly defined and in the four large white spots on the tegulæ and patagia. It is also a much smaller insect.

Halisidota striata, n. sp.

♀. Palpi 1st joint ochreous, 2nd black above, ochreous beneath, 3rd black; head buff with large black spot between antennæ; antennæ pale buff; collar black with three large buff spots; thorax buff with black dorsal line; patagia black with three buff spots; abdomen orange, laterally and dorsally spotted with black; pale buff beneath with ventral and lateral rows of darker patches irregularly bordered with black. Fore-wings pale buff, a black spot at base; a dark brown basal line from costa to vein 1 strongly angled outwards on median vein; a fine longitudinal dark line in cell at base and a similar one between median and vein 1. Medial area crossed by numerous striæ from costa to inner margin broken on median vein; discocellulars black. Veins dark brown, darkest in terminal area. A dark longitudinal streak between veins 5 and 6; a sub-terminal row of spots surrounded by black, large above vein 1,

small above 2, 3 and 4, large above 5, 6 and 7 the last being crossed by a black bar. Termen finely black. Cilia buff, tipped with black at apex. Hind-wings ochreous-white, semi-transparent, long buff hairs on inner-margin, veins darker ; a dark discocellular spot ; an outer line angled acutely outwards between veins 5 and 6 and a terminal line bent inwards at the same place, meeting the other line and forming two enclosed spaces. Under-side : fore-wings marked as on upper-side but less distinct ; hind-wings the same as upper-side but more distinct.

Expanse 46 mm.

Hab. Castro, Paraná.

Halisidota ronda, n. sp.

♂. Palpi, 2nd joint orange crossed by black band ; head creamy-grey, darker between antennæ ; base of antennæ orange ; antennæ reddish-brown ; an orange patch on fore tibiæ ; collar pale buff with four black patches ; thorax pale buff with dark dorsal line ; patagia with sickle-shaped creamy-white mark bordered with black ; abdomen orange with dorsal row of black spots ; lateral row of pale buff spots ringed with black ; anal tuft pale buff ; under-side of abdomen creamy-white with ventral and lateral darker spots. Fore-wings pale buff irrorated with dark brown and crossed by 5 rows of creamy-white spots ringed with brown ; a small orange spot at base of median vein ; a dark shade at base of wing between rows 1, 2 and 3, 4, also between 4, 5 from vein 5 to costa ; two creamy-white spots beyond cell above veins 5 and 6. Hind-wings creamy-white, pale buff towards inner margin ; well-defined postmedial and subterminal lines, the space between being rather darker than the rest of the wing.

Expanse 46 mm.

Hab. Castro, Paraná.

Halisidota aurata, n. sp.

♀. Palpi and upper-side of fore femora orange-brown ; head thorax and antennæ bright fawn colour, thorax cream coloured posteriorly ; abdomen fawn, cream coloured at base and last segment ; under-side of thorax and abdomen cream. Fore-wings bright chrome-yellow ; costa narrowly cream-coloured followed by orange to subcostal ; an orange spot at base of median followed by slate-coloured stripe reaching nearly to termen close to apex : cilia creamy-white. Hind-wings creamy-white.

Expanse 42 mm.

Hab. Castro, Paraná.

Halisidota dallipa, n. sp.

♂. Pale ochreous. Upper-side of palpi, head antennæ and tegulæ light brown. Patagia with black point in front. Abdomen dorsally light brown. Primaries ochreous irrorated with brown scales distributed in ill-defined oblique transverse lines ; costa and margins slightly tinged with yellow ; a black point on base of veins 4 and 5 ; a sub-terminal row of minute specks ; fringe creamy-white. Secondaries semihyaline creamy-white shaded by indistinct row of spots on outer-margin ; spots well defined above veins 5 and 6.

Expanse 41 mm.

Hab. CASTRO, Paraná.

Halisidota ? fuscosa, n. sp.

♂. Brown. Palpi ochreous, 3rd joint brown ; head antennæ and thorax brown ; abdomen dorsally fuscous ventrally ochreous ; patagia with a black point in front. Fore-wings brown very sparsely speckled with black, the veins rather darker ; a black point on base of veins 4 and 5 ; a faint dark spot beyond cell and at apex ; two yellowish-brown spots in cell and one beyond cell ; a very oblique row of yellowish spots from before middle of inner-margin meeting sub-terminal row just below costa ; cilia ochreous. Hind-wings dark fuscous ; costa ochreous. Under-side : fore-wings as on upper-side, but the yellow much more decided and base yellow, the spot beyond the cell very distinct ; a sub-terminal series of yellowish spots followed by black points : hind-wings fuscous ; costal area yellow ; dark shades on termen near tornus and at apex.

Expanse 40 mm.

Hab. CASTRO, Paraná.

Æmilia suffusa, n. sp.

♂. Palpi head and tegulæ fuscous ; antennæ stalk ochreous, pectinations fuscous-brown ; thorax ochreous suffused with fuscous, a fuscous stripe on patagia ; abdomen ochreous, a sub-lateral row of coalescent fuscous spots, ventral surface suffused with fuscous. Fore-wings ochreous suffused and irrorated with fuscous ; a small fuscous fascia from base to termen below vein 6 where it coalesces with apical patch ; a small fuscous patch on inner margin near base, on sub-median fold near tornus and above vein 6 ; an indefinite sub-terminal row of elongate spots, and terminal streaks between the

veins. Hind-wings ochreous-white, slightly suffused with fuscous at apex.

Expanse 38 mm.

Hab. Castro, Paraná.

Antarctia nitida, n. sp.

♂. Head and thorax dark brown : antennæ ochreous-grey ; abdomen brown with lateral yellow stripes. Fore-wings brown. Hind-wings creamy-white ; veins, costa and termen brown. Under-side : fore-wings brown with yellow tuft at base ; whitish below median vein to inner margin ; hind-wings creamy-white, costal area heavily suffused with brown ; a brown lunular discocellular spot.

Expanse 35 mm.

Hab. Castro, Paraná.

Antarctia reversa, n. sp.

♂. Head and thorax dark rufous-brown ; antennæ light brown ; abdomen golden-yellow above and dark brown beneath. Fore-wings creamy-white suffused with brown at termen, veins rufous-brown a very dark fascia on costal area terminating in a point above vein 8 at apex ; inner margin to sub-median suffused with brown. Hind-wings white ; costa brown. Under-side : fore-wings white the veins brown on outer half ; costa dark brown. Hind-wings white ; costa golden-brown ; termen finely brown on outer half.

Expanse 34 mm.

Hab. Castro, Paraná.

Antarctia pectinalis, n. sp.

♂. Palpi, head pectus and legs dark brown ; femora orange ; antennæ brown, the pectinations very long ; thorax brown ; abdomen dorsally orange, ventrally brown, a brown dorsal terminal patch. Fore-wings brown, centrally lighter and somewhat translucent ; some yellowish hairs on inner margin at base. Hind-wings white suffused with yellowish-brown ; costa and termen brown.

♀. There is no dark patch on the abdomen, last segment white.

Expanse ♂ 38 mm. ; ♀ 45 mm.

Hab. Castro, Paraná.

Antarctia gigantea, n. sp.

♂. Head and thorax dark brown, collar edged with dull golden-yellow ; antennæ dark brown ; abdomen yellow with brown bands,

blackish-brown beneath; tibiæ yellow on upper-side. Fore-wings brown, dark at base and costa, paler and yellowish on outer half of wing; inner margin dark. Hind-wings yellow, costa narrowly brown; a wavy suffused sub-terminal band, interrupted between veins 3 and 4; termen finely golden-yellow; cilia golden-yellow. Under-side: fore-wings yellowish-grey; cell and costal area suffused with brown; veins brown. Hind-wings yellow suffused with brown on costal and terminal areas.

♀. Head and thorax dark brown; base of antennæ orange; upper-side of femora orange; abdomen yellow with brown bands, last segment brown; under-side almost black. Fore-wings brown; costal area and basal area suffused with very dark brown; veins dark; very obscure postmedial and sub-terminal dark diffused lines. Hind-wings basal area yellow; medial and outer areas brown; a broad suffused dark sub-terminal band interrupted between vein 3 and 4; cilia yellow suffused with brown, darker at ends of veins. Under-side: both wings brown, yellow at base.

Expanse ♂ 53 mm.; ♀ 72 mm.

Hab. CASTRO, Paraná.

Family NOCTUIDÆ.

Sub-family *AGROTINÆ*.

Lycophotia ignirena, n. sp.

♂. Head and thorax brownish-grey; abdomen ochreous. Fore-wings brownish-grey irrorated with dark brown; sub-basal line dark brown most distinct on costa and median vein; antemedial line faint light brown, dark on costa; postmedial well defined, terminating in dark spot on costa; sub-terminal less distinct, approaching postmedial at inner margin; claviform round, dark rufous; orbicular and reniform ochreous bordered by light rufous-brown. Hind-wings white.

♀. Darker than ♂. Fore-wings suffused with brown; lines obscure. Hind-wings white.

Expanse 30 mm.

Hab. CASTRO, Paraná.

Lycophotia atriclava, n. sp.

♀. Palpi and head grey irrorated with fuscous-brown; tegulæ grey; thorax grey, the patagia being heavily sprinkled with fuscous;

abdomen ochreous-grey. Fore-wings grey suffused with brown and irrorated with fuscous ; a black sub-basal line visible only on costa and between median and submedian veins ; a black antemedial line angled inwards on submedian, coalescing with pronounced black claviform ; a somewhat diffused excurved postmedial line slightly bent inwards on sub-median fold and beyond cell, followed by light line ; obscure medial and sub-terminal dark shades ; orbicular and reniform light grey with dark centre and outer ring, a dark shade in cell between them ; a terminal row of dark lunules ; cilia brownish-grey with light grey band. Hind-wings ochreous-white slightly suffused with brown, heaviest at apex.

Expanse 34 mm.

Hab. CASTRO, Paraná.

Episilia diagramma, n. sp.

♀. Ochraceous-brown. Fore-wings irrorated with dark brown ; a dark fascia on median vein from base to postmedial line, darkest at base ; postmedial very oblique, consisting of separate dots from inner margin to vein 5, merging into diffused dark area at apex ; a row of black dots on termen and a dark shade on outer half of inner margin ; orbicular and reniform reduced to minute black dots. Hind-wings semihyaline suffused with ochreous on costa and termen ; a dark interrupted terminal line.

Expanse 38 mm.

Hab. CASTRO, Paraná.

Sub-family *HADENINÆ*.

Chabuata poliosigma, n. sp.

♀. Palpi dark brown, 3rd joint rufous ; antennæ and abdomen rufous-brown ; thorax olive-brown. Fore-wings olive-brown suffused with rufous-brown, basal and antemedial lines obscure ; postmedial bent inwards on median fold, outwards on vein 4 and inwards on vein 6 ; a light brown sub-terminal line bent inwards between veins 5 and 6 and followed by dark shade ; minute geminate black dots on veins 1 to 6 between postmedial and sub-terminal lines ; a dark triangular mark on costa near apex reaching to vein 7 ; reniform light grey bordered by narrow black line outwardly and surrounded by dark shade ; orbicular represented by two minute grey dots. Hind-wings brown, cilia rufous.

Expanse 42 mm.

Hab. CASTRO, Paraná.

Chabuata phæozona, n. sp.

♀. Palpi rufous-brown, 3rd joint ochreous; head and thorax rufous; abdomen light brown. Fore-wings light brown with two broad dark violaceous brown bands, the first between sub-basal and antemedial lines and the second between postmedial and sub-terminal; median vein and veins 1 to 4 dark violaceous-brown to sub-terminal line; a suffused dark medial shade; orbicular paler than wing with dark brown dot at upper inner corner; reniform pale with dark bicuspid spot at lower end, touching median vein; a dark spot at base of cell; a terminal row of minute black dots between the veins. Hind-wings brown, darkest at apex; basal half of costal area ochreous, iridescent. Under-side: fore-wings brown suffused with rufous at costa and termen; hind-wings irrorated with brown and suffused with brown on costal area; an indistinct brown postmedial line and well defined almost black discocellular spot.

Expanse 43 mm.

Hab. CASTRO, Paraná.

Chabuata nictitans, n. sp.

♂. Palpi dark brown outwards, light brown inwardly; head, thoracic crest and abdomen brown; patagia rufous-brown; tegulæ rufous-brown fringed posteriorly with ochreous; abdominal crest brown with whitish points; anal tuft yellowish-brown. Fore-wings glossy violaceous-brown; sub-basal line geminate, dark, excurved, followed by minute black dot in base of cell; antemedial line geminate, enclosing lighter shade, scalloped outwardly from inner margin to submedian and on median fold, displaced inwardly on median and violently bent outwards on subcostal; a dark medial fascia curved outwards to end of cell; postmedial line geminate, indistinct, dentate, incurved from inner margin to vein 4, straight from 4 to 7 where it bends violently inwards to costa; the inner of the two lines the more distinct; followed by row of black dots on veins; a sub-terminal line inwardly ochreous, outwardly black, excurved from vein 2 to 5, bent violently inwards on vein 7; a terminal row of black spots between the veins; termen crenulate; cilia ochreous inwardly, brown outwardly; medial area and outer portion of basal area below subcostal suffused with dark brown, extending to medial fascia and just beyond reniform; orbicular and reniform ochreous-white suffused with brown, lower end of latter dark brown; a fine ochreous white line on submedian arched at orbicular joins the two spots; a dark brown spot between veins 5 and 6 at sub-terminal line. Hind-wings dark brown; cilia light brown.

Under-side : fore-wings brown suffused with light violaceous on costa and terminal area ; a well-defined dark postmedial line. Hind-wings ochreous suffused with violaceous and irrorated with dark brown on the veins ; a well-defined dark postmedial line and discocellular spot.

Expanse 42 mm.

Hab. São Paulo.

Chalnata ochrias, n. sp.

♀. Light ochreous-brown. Palpi dark olive-brown, 3rd joint ochreous. Fore-wings pale ochreous ; antemedial line wavy geminate indistinct, enclosing light shade, angled inwards on submedian, outwardly on median and inwardly on subcostal ; a γ-shaped dark medial fascia including reniform ; postmedial inwardly black indistinct lunules, outwardly light followed by black dots on the veins ; subterminal wavy, excurved from vein 2 to 5 and between 6 and 7, preceded by dark band shading off to light at postmedial ; terminal line scalloped, brown ; cilia ochreous edged with brown. Hind-wings brown. Under-side : fore-wings ochreous, suffused with brown to postmedial line, iridescent on inner margin ; hind-wings ochreous irrorated with brown ; an indistinct postmedial line and well-defined discocellular spot.

Expanse 41 mm.

Hab. Castro, Paraná.

Eriopyga nigridorsia, n. sp.

♀. Palpi outwardly brown, inwardly ochreous, 3rd joint ochreous ; head ochreous ; thorax ochreous mixed with light brown ; femora and tibiæ heavily clothed with reddish-brown hairs ; tarsi ochreous ; abdomen dorsally smoky-black, ventrally fawn-colour ; anal tuft light fawn. Fore-wings light brown, basal and terminal areas darker than medial, antemedial line excurved from inner margin to median vein ; a dark medial fascia angled outwards on median vein and outwardly diffused in cell, including reniform ; orbicular small, enclosed in pale ring ; reniform large, enclosed in pale ring. Hind-wings ochreous suffused with brown, the veins dark. Under-side : fore-wings ochreous centrally suffused with brown, an almost straight postmedial line, most distinct at costa ; terminal area suffused with light rufous-brown ; hind-wings ochreous irrorated with brown, especially at costa, a very faint postmedial line and a distinct dark discocellular spot.

Expanse 40 mm.

Hab. Castro, Paraná.

Eriopyga approximans, n. sp.

♀. Light rufous-brown ; abdomen suffused with light brown and thinly irrorated with nearly black scales. Fore-wings medial area darker than the rest of the wing ; antemedial and postmedial lines geminate, nearly straight and converging towards inner margin ; an indistinct dark medial fascia and dark shade in cell ; costal area irrorated with black ; a pale wavy sub-terminal line ; orbicular and reniform dark, surrounded by pale line ; cilia ochreous with geminate pale brown bands. Hind-wings white suffused with brown on costa and at apex, termen brown. Under-side : fore-wings, centrally brown ; costal and terminal areas rufous ; hind-wings white suffused with rufous on costa and apex ; a very minute discocellular spot.

Expanse 36 mm.

Hab. CASTRO, Paraná.

Eriopyga atrisignata, n. sp.

♂. Ochreous-brown ; abdomen dorsally brown, lateral tufts fawn-colour, anal tuft yellowish, underneath fawn ; legs pinkish-fawn. Fore-wings lines very obscure except the postmedial which consists of minute black dots on veins ; a minute black spot at base of cell ; a smaller dot on submedian at antemedial line ; orbicular and reniform black. Hind-wings ochreous suffused with brown, veins darker, iridescent at base. Under-side : fore-wings centrally brown, costal area pinkish-fawn irrorated with dark brown ; a well-defined postmedial line ; hind-wings, ochreous suffused with fawn at base, irrorated with dark brown at costa and apex ; indistinct postmedial line and discocellular spot.

Expanse 34 mm.

Hab. CASTRO, Paraná.

Sub-family *CUCULLIANÆ*.

Cucullia perlucida, n. sp.

♂. Palpi fuscous and white in front, fuscous behind, 3rd joint dark fuscous ; frons fuscous ; vertex fuscous and grey, white tufts at base of antennæ ; antennæ rufous ; tegulæ fuscous and grey with a fine posterior dark line ; prothoracic tuft grey white and brown ; thorax light brown and white, a few scattered black scales, a broad fuscous dorsal stripe ; abdomen ochreous, dorsally suffused with

brown, a fuscous dorsal stripe. Fore-wings: costa convex from middle to apex; apex rounded; ochreous-white suffused with light brown, veins darker; dark on costa and inner margin; antemedial line narrow black and very angular, violently angled inwards on vein 1, outwards on submedian fold which it follows inwardly nearly to base, then bends outwards to an acute angle in the cell; post-medial wavy to vein 2 which it follows inwardly to near origin of same, then outwards below cell to vein 4 where it bends inwards to near upper angle of cell; a narrow black fascia between veins 4 and 5; costa strigulated with fuscous; inner margin and termen narrowly diffused black; a dark fascia on terminal area below vein 2; a dark diffused fascia from near middle of inner margin to middle of vein 2; some diffused dark marks between veins 5 and 7; submedian area translucent-white; cilia much longer above vein 3 than below it, ochreous-white with two bands, the inner being the darker of the two. Hind-wings white, veins pale brown; termen narrow pale brown; cilia white.

Expanse 45 mm.

Hab. Castro, Paraná.

Hypnotype jucunda, n. sp.

♀. Palpi black, 2nd joint with white point, 3rd joint with black spot: frons white in front, black behind; vertex greenish-white with black central spot; tegulæ and antennæ brown; thorax greenish-white spotted with black; front of patagia black, crest very pale stone-green; abdomen brown segments posteriorly ochreous; anal tuft ochreous and white, underneath black; ciliæ of fore femora black; tibiæ and tarsi black and white; ciliæ of mid and hind femora white, tibiæ and tarsi black and white. Fore-wings pale whitish-green suffused with dark brown from base to post-medial line on inner margin and nearly to apex on costa: base black enclosing geminate green spot; sub-basal line silvery-white, very broad at base of cell; antemedial white excurved below submedian, incurved on submedian, excurved on subcostal, obscured on costal area by green patch which joins the orbicular; a circular green patch below median joining the orbicular, both being narrowly bordered with black; a green patch on inner margin between the sub-basal and antemedial lines; reniform green fading to white outwardly and surrounded by black strigulæ on costa and at medial portion of inner margin; a large triangular black spot on the end of vein 2 and a smaller one on vein 5; a terminal line of black lunules preceded by white: cilia inwardly green, outwardly white on veins

and black between. Hind-wings smoky-brown, terminal area darkest, veins dark; an indistinct suffused postmedial line; cilia ochreous with broken brown band. Under-side: fore-wings ochreous heavily suffused with smoky-brown, terminal area darkest; four green dots on costa at apex; hind-wings ochreous-white irrorated and suffused with smoky-black, terminal area darkest; a well-defined discocellular spot.

Expanse 38 mm.

Hab. CASTRO, Paraná.

Sub-family *ACRONYCTINÆ.*

Heterochroma albipuncta, n. sp.

♂. Palpi, head, antennæ and legs rufous-brown; tarsi smoky terminating with ochreous on each joint; thorax dark violaceous-brown; abdomen brown, first three segments laterally ochreous, crest on 1st segment dark grey, on 2nd and 3rd dark fawn-colour. Fore-wings dark violaceous-brown; antemedial line lighter, a dark shade inwardly; a broad dark medial fascia; postmedial line strongly excurved beyond cell; a terminal row of short black lines with white spot between the veins: a dark space between subcostal and antemedial lines from inner margin to submedian, containing minute white spot; a white spot on reniform; a large lunular dark spot near apex with four minute whitish dots on costa. Hind-wings creamy-white heavily suffused with smoky-brown on terminal area and less heavily on costal area. Under-side: fore-wings ochreous heavily suffused with brown; a broad dark suffused medial band; suffused postmedial and sub-terminal lines; a terminal row of ochreous spots at the ends of veins; four ochreous spots on costa near apex; hind-wings ochreous suffused with violaceous-brown and irrorated with smoky-brown on costa and apex; a broad dark antemedial line best defined at costa; a dentate wavy postmedial and diffused sub-terminal lines.

Expanse 37 mm.

Hab. CASTRO, Paraná.

Cropia poliomera, n. sp.

♀. Palpi head and antennæ brown; cilia of legs violaceous-brown; tarsi brown, each joint terminating with ochreous; tegulæ ochreous; thorax ochreous thickly mottled with brown; abdomen brown. Fore-wings glossy brown; medial area darkest of the three; a dark excurved medial fascia; sub-basal line black; antemedial

line light brown edged outwardly with black; postmedial lighter than antemedial, nearly white on subcostal, dentate, bordered inwardly with black from inner margin to vein 3; sub-terminal line similarly coloured, crenulate, shaded inwardly with black between veins 1 and 4. A terminal row of dark lunular spots between the veins; a dark patch between postmedial and sub-terminal lines at costa with two minute ochreous spots on costa; cilia ochreous with brown band and brown points; orbicular and reniform light brown, the latter containing white lunular spot outwardly. Hind-wings brown, terminal area darkest; an indistinct pale postmedial line. Under-side: fore-wings brown irrorated with ochreous on costal and terminal areas; diffused antemedial, postmedial and sub-terminal lines, most conspicuous on costa; a dark discocellular spot. Hind-wings ochreous irrorated with brown; a diffused dark antemedial line; a well-defined postmedial crenulate line, nearly meeting antemedial on costa; a suffused sub-terminal line; cilia ochreous with brown band, dark brown at tornus.

Expanse 35 mm.

Hab. Castro, Paraná.

Trachea eugrapha, n. sp.

♂. Palpi dark brown; head thorax and fore-wings violaceous-brown; abdomen, basal half light brown, terminal half purple-brown; anal tuft fawn above, white beneath; mid tibiæ thickly clothed on upper side with violaceous-brown scales. Fore-wings violaceous-brown; inner margin curved outwards near base, then excavated; antemedial line black, strongly angled inwards on vein 1, followed by greenish broad band containing orbicular; a black excurved medial fascia, broadest on costal area; an indistinct geminate postmedial line; sub-terminal line wavy, green, crossed between veins 4 and 6 by two black streaks; excavated portion of inner margin green; cilia ochreous with broad brown band interrupted at the veins; reniform light brown with black line in centre. Hind-wings brown, darkest on terminal area, veins dark; cilia ochreous with geminate dark spots at veins 2, 3 and 4.

Expanse 29 mm.

Hab. Castro, Paraná.

Chytonix glaucescens, n. sp.

♂. Thorax greenish-ochreous; abdomen pale brownish-ochreous. Fore-wings glistening greenish-ochreous; basal line black, only visible on costa and a dot below median vein; antemedial line

visible on costa, in cell and a dot below median; postmedial geminate, strongly excurved beyond cell, the inner member broad and diffused, followed by whitish spot on costa and inner margin, the outer broken into dots and followed by whitish line; an indistinct whitish sub-terminal line and a large whitish space at apex; termen suffused with black and edged with black between the veins. Hind-wings glistening ochreous suffused with brown outwardly; a dentate postmedial line with dark points on the veins; a dark discocellular spot.

Expanse 27 mm.

Hab. CASTRO, Paraná.

Oligia nyctichroa, n. sp.

♂. Head and thorax violaceous-brown, a few scattered grey scales on tegulæ; abdomen ochreous thickly scaled with brown dorsally, anal tuft brown above and fawn-coloured beneath. Fore-wings: basal area very dark; first half of medial area light, second half dark, a black medial fascia; antemedial line geminate, black, enclosing light violaceous, excurved below submedian, on median fold and on costal area; postmedial geminate, wavy, straight from inner margin to vein 2, bent outwards to above vein 4, incurved to 7 and 8, where there is a white spot outwardly dentate, then violently bent inwards to costa; a sub-terminal row of diffused dark spots; termen black, interrupted at veins, whitish dots on the veins; orbicular and reniform purplish-grey, outwardly defined by black; a whitish spot on costa above reniform followed by three white points and a larger spot at apex. Hind-wings brown; termen dark; cilia light inwardly, dark outwardly.

Expanse 23 mm.

Hab. RIVER PARANAPANEMA, Paraná.

Macapta excisa, n. sp.

♂. Thorax pinkish-brown. Fore-wings light brown suffused with roseate, excavated between vein 4 and apex, a minute ochreous spot at base of cell; a dark brown simple slightly diffused antemedial line, excurved at costa and inner margin, almost straight between; a dark brown similar postmedial line strongly excurved beyond cell and angled outwards on veins 5, 6 and 7, followed by dark brown dots on veins; an indistinct suffused brown sub-terminal line bent inwards between veins 2 and 3; reniform creamy-white centrally rufous and defined by brown. Hind-wings brown, basal half of

costal area white; discocellular spot defined by dark ring. Underside: fore-wings ochreous suffused with brown in and below cell as far as postmedial line, rufous on costal and terminal areas; a well-defined sub-terminal line; reniform ochreous. Hind-wings ochreous suffused and irrorated with brown; veins mottled brown and ochreous; a well-defined sub-terminal line.

Expanse 22 mm.

Hab. São Paulo, S.E. Brazil.

Monodes miochroa, n. sp.

♂. Palpi and head light brown; tegulæ ochreous with broad suffused band posteriorly; thorax dark brown; abdomen light brown. Fore-wings light brown thickly irrorated and suffused with dark brown and black; base, and apex from end of cell to vein 3 light; medial area suffused with black; a diffused sub-basal line white inwardly and black outwardly; antemedial line geminate, black enclosing ochreous, strongly angled inwards on submedian, white points inwardly on submedian, median and subcostal; postmedial incurved from inner margin to vein 4, strongly excurved beyond cell, two large white lunules on margin and median fold; whitish along the line from this point to vein 6; a diffused brown sub-terminal line strongly excurved on veins 1, 4 and 7; veins dark to termen; termen dark brown, white points on veins 2, 3 and 4; cilia light brown, dark at the ends of veins. Hind-wings ochreous-white slightly irrorated with brown on basal half, heavily at apex; postmedial and sub-terminal diffused brown wavy lines; termen finely dark brown; cilia ochreous with broad brown band; dark brown discocellular spot.

Expanse 21 mm.

Hab. Castro, Paraná.

Monodes hemileuca, n. sp.

♀. Palpi and antennæ light brown; thorax creamy-white; abdomen light brown. Fore-wings creamy-white irrorated with fawn-colour and light brown; basal half light to antemedial on costa and postmedial on inner margin; a faint antemedial fawn-coloured wavy line slightly excurved at cell; a broad diffused oblique medial fascia; postmedial dark brown, outwardly whitish, excurved from inner margin to vein 4, then bent outwards to above vein 5 where it bends violently inwards to subcostal, touching reniform and enclosing a dark space; a diffused wavy sub-terminal line beyond which veins suffused with brown; a large creamy-white spot at apex outwardly defined

by dark brown; reniform oblique, creamy-white shaded inwardly with a few dark scales. Hind-wings ochreous suffused with brown; an indistinct diffused sub-terminal line; a brown lunular discocellular spot.

Expanse 26 mm.

Hab. CASTRO, Paraná.

Monodes polysticta, n. sp.

♀. Palpi head antennæ, thorax and abdomen violaceous-brown. Fore-wings light reddish-brown; base black; antemedial line geminate, black, broken into minute dots, bent inwards on submedian and median and outwards on subcostal a narrow brown medial fascia; postmedial broadly geminate, incurved from inner margin to vein 4, straight to vein 8, then violently bent inwards to costa, followed by double rows of black dots on veins; a wavy diffused sub-terminal line followed by dark shade to termen, the veins being darker and marked with white points on termen; an apical white spot and three white points on costa; orbicular creamy-white defined and centrally suffused with brown; reniform with dark diffused spot at lower end; a minute white dot followed by black on median fold at origin of vein 2. Hind-wings brown. Under-side: fore-wings ochreous suffused with dark brown centrally and light reddish-brown at costa and terminal area; postmedial and subterminal diffused dark brown lines some white marks on costa from postmedial to apex; hind-wings ochreous suffused with reddish-brown on costal and apical areas; a wavy sub-terminal line excurved at veins 3 and 4; a dark discocellular spot.

Expanse 23 mm.

Hab. CASTRO, Paraná; SÃO PAULO, S.E. Brazil.

Monodes chlorozona, n. sp.

♀. Palpi and antennæ brown; vertex grey; tegulæ olive-brown in front, grey behind; thorax grey mixed with olive-brown; abdomen yellowish-brown. Fore-wings: base lilacine-grey; sub-basal line black, inwardly oblique from median vein to inner margin, space from basal to sub-basal olive-green; a wavy interrupted antemedial line inwardly white outwardly black; space between sub-basal and antemedial lilacine-grey suffused with brown on lower half; a crenulated postmedial line strongly angled outwards at cell, inwardly black, outwardly white; medial area olive-green with light ochreous space on inner margin, a diffused black fascia from costa to median fold; terminal area lilacine-grey outwardly olive-green

from apex to vein 3, a white triangular spot at tornus and white mark at apex; termen black interrupted at veins. Hind-wings ochreous suffused with brown; termen darker brown; cilia ochreous inwardly, brown outwardly.

Expanse 14 mm.

Hab. CASTRO, Paraná.

Monodes phæoplaga, n. sp.

♂. Palpi, head and thorax olivaceous; abdomen brown. Fore-wings ochreous; base olivaceous; basal and sub-basal lines black; a wavy dark antemedial line diffused from costa to cell; medial area from costa to vein 2, dark olivaceous; postmedial line strongly excurved beyond cell, angled inwards on vein 2 and outwards on vein 1, followed by broad ochreous band, broadest at vein 3 where there are two brown spots, narrower on vein 5, thence bent outwards to apex; terminal area olivaceous, a dark spot above vein 6; termen dark brown; cilia olivaceous; reniform rufous. Hind-wings ochreous, suffused with brown from postmedial to termen; termen brown; a diffused dark lunular spot on discocellulars.

♀. Darker than ♂; medial area almost black, the dark shade terminating on median fold with a well-defined black streak joining the ante- and post-medial lines; the spots at vein 3 united and coalescing with medial dark area.

Expanse ♂ 16 mm, ♀ 17 mm.

Hab. CASTRO, Paraná.

Monodes ditrigona, n. sp.

♂. Palpi, head and tegulæ rufous; thorax lilacine-grey; abdomen ochreous. Fore-wings white suffused with lilacine-grey lightest at costa; two large black triangular marks on costa, the first extending from the base to one-third of the wing, the apex being in the cell at orbicular where it coalesces with the apex of a small triangular mark based on median vein; the second follows immediately beyond the first and extends to postmedial line, the apex being at the end of the cell. Hind-wings white, semihyaline, irrorated with brown on costal area.

Expanse 26 mm.

Hab. CASTRO, Paraná.

Gonodes dianiphea, n. sp.

♂. Palpi ochreous, scaled outwardly with black; head and thorax light reddish-brown mixed with grey; tegulæ with a brown

posterior band fringed with grey; abdomen light brown above, ochreous beneath; a dark diffused dorsal spot on 1st segment. Fore-wings light reddish-brown excavated from tornus to veins 3, 4 and thence to apex; a black spot at base of costa; a black basal line interrupted at cell, well defined on costa, faint below cell; a diffused brown antemedial line excurved on subcostal incurved on submedian; a dark diffused wavy medial fascia; a wavy dentate postmedial line incurved at inner margin and on median fold; straight from vein 3 to 7 then bent violently inwards to costa, followed by black dot on all the veins; a suffused brown sub-terminal line incurved from tornus to vein 2, excurved on 3, 4 and incurved thence to apex; termen dark reddish-brown lunules between the veins; a black streak on base of median vein; a dark streak across medial area below median vein, wide on ante- and pointed on post-medial line; a creamy-white club-shaped spot in lower angle of cell, including red brown discocellulars; a creamy-white streak from lower angle of cell above vein 3 to termen, a black streak above this forms the base of a dark brown triangle terminating at apex. Hind-wings ochreous-white suffused with brown on terminal area; a diffused dark brown discocellular spot.

Expanse 27 mm.

Hab. CASTRO, Paraná.

Matopo neotropicalis, n. sp.

♂. Head and thorax dark violaceous-brown; abdomen ochreous. Fore-wings ochreous heavily suffused with dark brown on costal area, basal and antemedial lines obscure, a few scattered black scales on basal half of wing; a dark brown medial fascia angled outwards at lower angle of cell; an indistinct light brown postmedial line followed by pale ochreous; terminal area veins dark, dark geminate lines between the veins. Hind-wings white.

Expanse 32 mm.

Hab. CASTRO, Paraná.

Atrephes phocea, n. sp.

♂. Palpi, head and thorax brown; abdomen ochreous with yellowish-brown crests. Fore-wings brown, basal and antemedial lines black, obscure; postmedial dark brown followed by narrow pale line, excurved from costa to vein 5, thence straight to inner margin near tornus; sub-terminal line obscure, represented by dark diffused spots between the veins; terminal lunules between the veins; medial area darker than rest of wing; cilia brown, ochreous

at points of veins. Hind-wings glossy ochreous-white sparsely irrorated with dark brown, veins on termen darker; cilia ochreous with brown band.

Expanse 30 mm.

Hab. Castro, Paraná.

Cosmia xanthea, n. sp.

♂. Palpi frons and antennæ brown; vertex and thorax light fawn-colour; abdomen ochreous-brown. Fore-wings fawn, inner margin and terminal area suffused with brown; a dark brown basal line angled inwardly at base of cell; an oblique nearly straight antemedial line from one-third on costa to middle of inner margin, inwardly white, outwardly black; a diffused brown interrupted medial fascia; a wavy postmedial line inwardly black, outwardly white, excurved on median fold thence incurved to vein 4, excurved beyond cell; an indistinct wavy sub-terminal line; orbicular and reniform pale, bordered by diffused brown. Hind-wings pale ochreous suffused with brown on the veins and at termen; discocellular spot indistinct.

Expanse 32 mm.

Hab. Castro, Paraná.

Doryodes monosticta, n. sp.

♂. Light brown. Fore-wings light brown suffused with rufous, the veins darker; very indistinct diffused brown postmedial and sub-terminal lines; a minute black spot on discocellulars. Hind-wings ochreous suffused with brown.

Expanse 22 mm.

Hab. Castro, Paraná.

Doryodis disticta, n. sp.

♂. Palpi head and thorax light brown; abdomen ochreous. Fore-wings light brown slightly irrorated with black; a black spot in middle of cell and another at discocellulars, the latter followed by a short black fascia below vein 6; a suffused dark shade above vein 6 to apex; apex slightly tinged with pink; a diffused dark spot on median fold near tornus; a terminal row of black points between the veins; cilia ochreous. Hind-wings ochreous outwardly suffused with brown.

Expanse 25 mm

Hab. Castro, Paraná.

Doryodes sanguifusa, n. sp.

♂. Palpi head antennæ and thorax light brown ; frons and vertex grey and ochreous. Fore-wings yellowish-brown; a deep pink fascia from base through the cell to apex ; the lower half of wing suffused with pink, especially on median fold and at inner margin ; an indistinct wavy pink, sub-terminal line ; short pink fasciæ between the veins on terminal area ; costal area slightly irrorated with pink ; a dark point on discocellulars. Hind-wings ochreous, slightly suffused outwardly with brown.

Expanse 22 mm.

Hab. CASTRO, Paraná.

Doryodes leucorhabda, n. sp.

♀. Palpi and antennæ dark brown ; head thorax and abdomen light yellowish-brown. Fore-wings light yellowish-brown ; black wavy ante- and post-medial lines, very obscure above subcostal, the former angled outwardly and the latter inwardly on median fold ; a black spot in middle of basal area below median vein ; a white fascia in lower half of cell and continued to apex broadly shaded on both sides with brown, a black line above the fascia in medial area joining the ante- and post-medial lines ; a terminal row of black lunules between the veins. Hind-wings ochreous ; a double diffused sub-terminal line, termen brown, heaviest at tornus ; a diffused brown discocellular spot.

Expanse 19 mm.

Hab. CASTRO, Paraná.

Parvapenna punctilinea, n. sp.

♂. Light brown. Fore-wings, sub-basal line black, only visible on costa ; ante- and post-medial lines represented by minute black dots on veins ; a minute black spot on discocellulars ; a terminal line of black lunules between the veins ; cilia very long, inwardly ochreous with line of suffused brown, outwardly brown. Hind-wings ochreous suffused with brown ; cilia the same as fore-wings but lighter in colour ; dark suffused lunular discocellular spot.

Expanse 20 mm.

Hab. SÃO PAULO.

Parvapenna arcuata, n. sp.

♀. Palpi outwardly brown, inwardly ochreous ; head and thorax lilacine-brown ; abdomen brown, dorsally banded with ochreous ;

anal tuft yellowish. Fore-wings lilacine-brown, the veins thickly irrorated with black and a few ochreous scales, especially on costal and terminal areas; antemedial line geminate, black, distinct below median vein and obscure to costa, outer line darker of the two; postmedial geminate, black, distinct from inner margin to vein 5, obscure to costa, inner line the darker; a terminal line of dark lunules between the veins; cilia long, ochreous with broad brown band and brown tips; a white fascia on median vein from base to beyond cell and continuing thence to apex, suffused with brown between veins 5 and 7; a suffused black spot in middle of cell and a second on discocellulars. Hind-wings ochreous suffused with brown outwardly, heaviest at apex.

Expanse 24 mm.

Hab. CASTRO, Paraná.

Sub-family, *HERMINIANÆ.*

Phrodita fasciata, n. sp.

♂. Palpi fawn-colour; antennæ, stem creamy-white, pectinations fawn-colour; head thorax and abdomen creamy-white; a broad black dorsal line on thorax. Fore-wings creamy-white, costa narrowly fawn-colour; a black fascia below median and vein 2 reaching or nearly reaching termen, preceded by black dot at base; a black fascia from middle of cell to termen preceded by minute black dot (sometimes absent) and crossed by white bar at discocellulars; black fasciæ between the veins on terminal area, that above vein 7 obscure or wanting. Hind-wings white.

Expanse ♂ 28–32 mm.; ♀ 32–40 mm.

Hab. CASTRO, Paraná.

Very close to *P. bilinea*, Schaus., but differs from it in the fasciæ on terminal area and the black line on the thorax.

Family SPHINGIDÆ.

Chlænogramma muscosa, n. sp.

♂. Palpi, 1st joint and base of 2nd white in front black behind, tip olivaceous; head thorax and abdomen olivaceous, a few white hairs at base of antennæ; patagia fringed with white, a lateral row of triangular dark spots on abdomen; under-side

of thorax and abdomen creamy-white. Fore-wings creamy-white heavily irrorated with olivaceous and black, some white hairs at base; a geminate black antemedial line strongly angled inwards on submedian; four wavy dentate black postmedial and sub-terminal lines, the first followed by green, the second by cream, the third by green, all thickly irrorated with black; a black zig-zag line from sub-terminal between veins 6 and 7 to apex; a white discocellular spot circled by black, the surrounding space being darker than the rest of the wing; cilia creamy-white alternating with black at the ends of the veins. Hind-wings ochreous-white heavily suffused with black on basal and terminal areas; a broad diffused postmedial band strongly excurved at tornus; cilia same as fore-wings. Under-side: fore-wings fuscous irrorated on costal and terminal areas with ochreous; three diffused dark bands and a pale discocellular spot; hind-wings ochreous shading to creamy-white at termen, irrorated with fuscous; three dark dentate postmedial bands, the first and second coalescing on median fold.

Expanse 115 mm.

Hab. CURITIBA, Paraná.

Neogene curitiba, n. sp.

♂. Palpi head and thorax dark fuscous, scattered grey hairs on patagia; abdomen dorsally dark fuscous irrorated with ochreous, laterally ochreous with row of large black spots; terminal segments and anal tuft are dark. Fore-wings ochreous-brown heavily suffused with fuscous, especially on basal and terminal areas; a white discal spot; cilia with white spots between the veins. Hind-wings creamy-white suffused with black on costa, broadly black at termen; cilia white interrupted at the ends of the veins. Under-side: fore-wings dark fuscous thickly irrorated with ochreous on basal and medial areas, more scattered on terminal area; base almost white. Hind-wings creamy-white suffused with black irrorated with ochreous on costa; a broad terminal black band as on upper side; veins black.

This species is closely allied to *N. reevsi*, Druce, but differs from it in the thorax being entirely dark, the fore-wings being entirely suffused with black and in the white discal spot and white spots on cilia.

Expanse ♂ 66 m.; ♀ 75 mm.

Hab. CURITIBA, Paraná.

Family NOTODONTIDÆ.

Lardaxima terminalba, n. sp.

♂. Palpi and frons reddish-brown; vertex and tegulæ rufous-fawn-colour; legs grey; thorax rufous and grey; patagia whitish in front, grey behind; abdomen ochreous dorsally suffused with brown, a violaceous-brown tuft on 1st segment, ochreous beneath, anal tuft ochreous. Fore-wings ochreous suffused and irrorated with light fuscous; base white; a geminate black sub-basal line angled outwards below cell and inwards on base of cell; a diffused geminate reddish-brown antemedial line angled outwards in the cell; medial, post-medial and sub-terminal paler than antemedial; a sub-terminal series of black points between the veins; two short black streaks on discocellulars; terminal area below vein 7 greyish-white. Hind-wings ochreous suffused with brown.

Expanse 44 mm.

Hab. São Paulo, S.E. Brazil.

Dasylophia robusta, n. sp.

♂. Palpi light brown irrorated with dark brown; frons, pectus, fore and mid coxæ, femora and tibiæ reddish-brown; vertex and tuft light brown; tegulæ darker; patagia light brown with dark brown fringe, two whitish streaks in front; thorax reddish-brown; abdomen fuscous-brown. Fore-wings light brown suffused with dark brown and fuscous; an obscure antemedial geminate line angled inwards on vein 1 and outwards on submedian fold, then excurved through cell to costa; a narrow dark brown postmedial line angled inwards on submedian fold, outwards on vein 3, then excurved to costa, preceded and followed by a light shade; a diffused dark medial shade; a diffused brown fascia in lower half of cell, followed by a black dot on discocellulars; a finer and darker streak in upper half of cell; a dark narrow fascia below median vein and a short streak at base below it; inner margin dark from near base to postmedial; some dark bars on costa; terminal area darker than the rest of the wing; a sub-terminal series of light lunules preceded by black between veins 2 and 4. Hind-wings ochreous suffused with brown, darkest on terminal area; veins brown.

Expanse 48 mm.

Hab. Castro, Paraná.

Eustema rapana, n. sp.

♂. Palpi and frons dark violaceous-brown; vertex, tegulæ and thorax brownish-grey; metathorax and base of abdomen violaceous-brown, remainder of abdomen brown. Fore-wings light brown suffused and irrorated with dark brown and with grey on costa and lower outer half of wing; a wavy diffused dark medial shade; a wavy brown postmedial line excurved beyond cell; an obscure sub-terminal brown line; a white fascia from inner margin near base to the upper side of the cell which it follows outwards, curving downwards at end of cell and terminating in a discoidal lunule; a triangular dark space beyond this fascia reaching nearly to tornus; a white spot on inner margin a little before middle.

Expanse 58 mm.

Hab. CURITIBA, Paraná.

Cerura splendens, n. sp.

♀. Head and thorax white; antennæ black, the stalk white at tip; a minute black spot on back of head; tegulæ with a few black hairs centrally and followed by strong black line bent upwards dorsally where it is followed by black tuft; two posterior black spots; abdomen silvery-grey suffused and banded with fuscous-black. Fore-wings brilliant silvery-white, a black spot on costa at base; a black basal line from costa to submedian, heavily marked below subcostal, interrupted on costal area and marked by short bar on costa; a geminate black antemedial line interrupted between submedian and cell, showing on inner margin as a black ring containing round lemon-white spot and on costa a γ-shaped mark containing two lemon-white spots—nearly reaching median vein, followed by three short black bars on costa and two on inner margin; a wavy black postmedial line bent outwards on veins 1 to 4, very broad on vein 1 and coalescing with subapical spot on costa, followed by lemon-white line very broad below vein 2 and between 4 and 6, and showing as a spot on the black at costa; cilia white with black spots between the veins, double between 1 and 2 and single from 2 to 7. Hind-wings white suffused with brown to postmedial and darker fuscous to termen. Under-side, fore-wings white suffused with fuscous, costa black, interrupted by white patch just before postmedial; a large white apical patch; hind-wings white suffused with fuscous, terminal area darkest.

Expanse 48 mm.

Hab. CASTRO, Paraná.

Schizura schausia, n. sp.

♂. Palpi reddish-brown mixed with white in front, 3rd joint tipped with white; legs brown, tarsi ringed brown and white; frons brown and white; a white tuft at base of antennæ in front, vertex black and white; tegulæ brown in front, then black, terminating with white; thorax black and white, centrally brown behind tegulæ; abdomen ochreous-brown, a black and white dorsal tuft on 1st segment. Fore-wings lilacine-brown suffused with fuscous; geminate ante- and post-medial lines enclosing lighter shade which becomes white on inner margin and costa; a dark medial shade; outer half of costa black with a broad hooked white stripe and white spots, sometimes confluent with the stripe; inner margin with white marks on medial area; termen black from tornus to vein 4 preceded by white and followed by black and white cilia; from vein 4 to apex brown and cilia brown. Hind-wings creamy-white, termen reddish-brown, tornus black and white. Underside: fore-wings creamy-white suffused with reddish-brown on base of costa, in cell and above vein 2; outer half of costa black with fine white spots; cilia white interrupted at the ends of the veins with black: hind-wings creamy-white; some brown diffused marks on costa; cilia white with some black points near tornus.

♀. Hind-wings suffused with brown.

Expanse ♂ 40 mm. ♀ 43 mm.

Hab. CURITIBA, Paraná.

Blera bella, n. sp.

♂. Palpi brownish fawn-colour, lighter in front; frons brownish-fawn; vertex and centre of collar olive-green; patagia whitish mixed with pinkish-fawn; thorax brownish-fawn and olive-green; abdomen fawn above, ochreous beneath; pectus and coxæ ochreous-fawn; tibiæ olive-green. Fore-wings white suffused with brownish fawn-colour; base white suffused with fawn, followed by olive-green band widening out greatly on costa and inner margin, then a narrow white line enclosing the rest of the wing with the exception of a triangular olive-green patch on costa; the space thus enclosed is brownish-fawn bordered by fawn; a dark suffusion at the end of the cell; a sub-terminal lilacine-grey suffusion reaching to cell between veins 2 and three; cilia fawn-colour and white, olive-green lunules at ends of veins 2, 3 and 4.

Expanse 38 mm.

Hab. CURITIBA, Paraná.

Family EUPTEROTIDÆ.

Carthara dolorosa, n. sp.

♀. Ochreous-grey. Fore-wings: geminate antemedial lines enclosing darker shade, the inner the broader of the two; similar postmedial lines strongly angled outwards on vein 4, above which the outer line is nearly as broad as the inner, the enclosed space darker above than below vein 4; a dark subapical shade; a dark lunule on discocellulars. Hind-wings darker than fore-wings. Under-side: fore-wings the outer line visible but indistinct; hind-wings more ochreous than upper-side, outer lines very distinct.

Expanse 35 mm.

Hab. CASTRO, Paraná.

Olceclostera castra, n. sp.

♀. Body ochreous-grey. Fore-wings ochreous irrorated with fuscous, especially on costal and terminal areas; a very wavy slightly diffused dark fuscous antemedial line; a less distinct similar postmedial line; a dentate submarginal line; termen ochreous; cilia fuscous; a large round fuscous spot at the end of the cell; a small hyaline spot between veins 5 and 6. Hind-wings glistening ochreous; two postmedial lines, the inner reddish-brown, the outer which is the more distinct of the two fuscous; termen finely brown. Under-side: fore-wings ochreous, a brown shade in the cell, dark on discocellulars; a wavy brown postmedial line, incurved from inner margin to vein 4, then outcurved to costa; hind-wings ochreous irrorated with brown and fuscous; double postmedial lines the inner one brown and the outer fuscous; a fuscous discal spot.

Expanse 35 mm.

Hab. CASTRO, Paraná.

Apatelodes quadrata, n. sp.

♂. Palpi dark brown; head and antennæ grey; thorax grey sprinkled with light brown and crossed by two fine light brown lines: a broad dark violaceous-brown band at end of thorax; abdomen ochreous-grey, lateral and terminal anal tufts violaceous-brown. Fore-wings grey finely irrorated with light brown; a double antemedial line only visible at inner margin and costa preceded by a white line and large dark violaceous-brown spot on inner margin; a brown postmedial line excurved beyond the cell; a brown fascia from antemedial on costa to postmedial a little below vein 2; a

dark violaceous-brown subapical spot crossed by veins 7 and 8 and followed by minute semihyaline spots, a larger semihyaline spot between veins 5 and 6. Hind-wings: basal half red-brown in the form of a square with the outer corner close to vein 6 from which point it extends in a nearly straight line to inner margin, and slightly excavated to costa followed by whitish line, broad at costa; terminal area fuscous-grey. Underside: fore-wing grey; double postmedial lines, the inner one being the broader; the apical hyaline spots followed by dark violaceous-brown which extends to apex. Hind-wings: the basal portions rich dark red-brown extending further towards termen than on upper-side, the outer corner produced with a blunt "tail" between veins 4 and 6; suffused with grey and irrorated with brown on costa and inner margin, the whole margined with white except at "tail"; terminal area grey irrorated with brown.

Expanse 41 mm.

Hab. CASTRO, Paraná.

Apatelodes lilacina, n. sp.

♀. Palpi brown; head and thorax grey; abdomen ochreous-brown. Fore-wings ochreous suffused with lilacine and irrorated with brown; lines obscure, the postmedial is double indicated by a bar on costa, the outer one by a few dark scales on veins 1 to 4; a large triangular dark brown spot on inner margin near base and a smaller one on costa near apex, below which is a vitreous spot above vein 6 scaled with white; terminal area suffused with dark brown between veins 3 and 6; a minute brown spot at upper angle of cell. Hind-wings ochreous suffused with lilacine; obscure post-medial lines, dark brown near tornus; a white streak from inner margin near tornus to vein 2. Under-side: fore-wings ochreous suffused and irrorated with rufous; costa light brown with creamy-white marks above vitreous spot; terminal area from vein 4 to apex rufous, below vein 4 brown; hind-wings yellowish, heavily irrorated with rufous, submedial region suffused with white crossed by dark band near middle of inner margin; a strongly excurved white line from $\frac{2}{3}$ on costa to inner margin near tornus.

Expanse 40 mm.

Hab. CASTRO, Paraná.

Apatelodes castanea, n. sp.

♂. Body rich chestnut-brown; thorax tinged with purplish-brown; basal segments of abdomen dorsally banded with dark

purplish-brown. Fore-wings chestnut-brown with conspicuous dark slightly excurved ante- and post-medial lines; a minute white spot near apex above vein 6; a minute dark point on discocellulars. Hind-wings chestnut-brown, ochreous at base. Under-side: fore-wings chestnut-brown, basal half, except costa, suffused with grey; white apical spot somewhat larger than on upper side; hind-wings chestnut-brown.

Expanse 40 mm.

Hab. CASTRO, Paraná.

Apatelodes paulista, n. sp.

♂. Palpi rufous-brown; head and thorax grey; antennæ ochreous; abdomen yellowish-brown. Fore-wings grey irrorated with yellowish-brown; a light brown wavy antemedial band; postmedial broader than antemedial, the outer edge being scalloped and darker than the rest; termen suffused with brown; cilia brown; a whitish discal spot. Hind-wings yellowish-brown; indistinct medial and postmedial lines; cilia grey. Under-side: fore-wings yellow-brown; medial and postmedial diffused brown lines, the latter followed by brown shade: hind-wings yellow-brown; similar lines to fore-wing, the postmedial angled outwards on vein 5; terminal area suffused with grey; a white discal spot.

♀. Very similar to ♂ but darker; the dark shade following postmedial line on under-side of wings being much more conspicuous than in ♂ and followed by greyish-white band.

Expanse ♂ 47 mm., ♀ 57 mm.

Hab. SÃO PAULO, S.E. Brazil.

Tarema fuscosa.

♂. Head antennæ and collar greyish olivaceous-brown, the latter paler posteriorly; thorax and abdomen olivaceous-brown. Fore-wings pale greyish-brown suffused on basal and medial areas with fuscous, and on terminal area with reddish-brown; antemedial line dark; postmedial light, from beyond middle of inner margin to ¾ on costa followed by whitish line from tornus to near apex, enclosing between them a dark space, reddish-brown below vein 4 and olivaceous above 4; from the last line to termen a dark shade, crossed by light line on vein 7, below which it is suffused with reddish-brown; a club-shaped whitish streak at the end of cell enclosing fuscous streak; a suffused reddish tinge at base and on inner margin. Hind-wings, basal half and inner margin to near

tornus greyish-brown; outer half fuscous suffused with reddish-brown; a diffused fuscous discal spot. Under-side: fore-wings greyish-brown heavily suffused and irrorated with fuscous to sub-terminal white line; terminally reddish-brown; discocellular mark more conspicuous than on upper-side. Hind-wings basally greyish-brown, not extending to near tornus as on upper-side; terminal half fuscous with slight reddish suffusion centrally; discocellular spot more conspicuous than on upper-side.

Expanse 32 mm.

Hab. CASTRO, Paraná.

Family SATURNIADÆ.

Automeris heisleri.

♂. Palpi and antennæ orange-brown; head, thorax and abdomen greenish-grey, a slight rufous tinge on frons; abdomen dorsally fuscous. Fore-wings greenish-grey; costa narrowly orange-brown; a fine orange-brown wavy antemedial line strongly angled outwardly in cell between origins of veins 2 and 3; a large darker grey spot at end of cell bordered by fine orange-brown line, outwardly light, inwardly dark; postmedial and sub-terminal lines very obscure; a nearly straight orange-brown line from $\frac{1}{3}$ on inner margin to apex outwardly shaded with dark grey; terminal area light; cilia reddish-brown. Hind-wings lemon-yellow, finely irrorated with dark grey and heavily suffused with fuscous on inner margin; sub-terminal line narrow, black, followed by reddish-brown band; termen greenish-grey, cilia reddish-brown; ocellus very large, black, thickly scaled with reddish-brown except at edges, a larger spot beyond cell and two small lateral spots, the large spot surrounded with fawn-colour except at outward end; a few scattered white scales in cell and at outward end of all the spots; a white discocellular streak.

Expanse 91 mm.

Hab. CURITIBA, Paraná.

Automeris grammivora.

♂. Palpi head and thorax reddish-brown; abdomen dorsally dull pink, ventrally dull yellow. Fore-wings light chestnut-brown, base white, an antemedial yellow line from subcostal, angled outwards on median, meeting by a short curve a very oblique postmedial yellow line outwardly shaded with brown that passes close below lower

angle of cell in nearly straight line to apex ; a very indistinct sub-terminal shade ; terminal area paler ; a minute white speck on discocellulars surrounded by obscure rufous spot, the enclosing line of which is merely indicated by four dots on median and veins 4, 5 and 6. Hind-wings dull pink ; a scalloped black sub-terminal line thickly irrorated with steel-blue scales, followed by a reddish-brown scalloped band ; terminal band pinkish-fawn ; termen finely brown ; cilia pinkish-fawn ; ocellus black surrounded by a lemon-yellow ring ; a clear white discocellular lunule surrounded by a patch of mixed fuscous and yellow scales defined by narrow yellow line. Under-side dull yellow irrorated with brown ; fore-wings a crenulate oblique fuscous postmedial line ; a large black spot with white central dot on discocellulars : hind-wings, a crenulate brown postmedial line ; an indistinct diffused brown sub-terminal line ; a minute white discocellular lunule.

♀. Body fuscous-brown, thorax posteriorly tinged with pink. Fore-wings fuscous-brown, lines as in ♂ but the antemedial very obscure and rufous, the postmedial inwardly whitish, outwardly rufous followed by dark shade. Hind-wings pink suffused with brown on costa ; terminal markings and ocellus as in ♂ but duller.

Expanse ♂ 72 mm., ♀ 88 mm.

Hab. CASTRO, Paraná.

Dirphia araucariæ.

♂. Head and thorax dark brown; antennæ light ochreous-brown ; abdomen dark rufous, dorsally banded with black. Fore-wings brown ; a very irregular fuscous sub-terminal shade, sharply defined outwardly, shading inwardly to lighter, boldly scalloped above veins 2 and 3, sharply receding inwardly on vein 4 ; a white line outwardly shaded wtih fuscous from base of costa, passing through middle of cell where it bends violently downwards to a point well below the cell on vein 2, from there to vein 5 just beyond cell and thence to near apex, the space enclosed by this line dark brown ; a similar white s-shaped line from base to inner margin near tornus, nearly reaching median fold opposite angle of the upper line, enclosing dark space ; a diffused fuscous discal spot. Hind-wings light fuscous-brown, veins and terminal area darker, some reddish-brown hairs at base and on inner margin ; a geminate dark sub-terminal line ; a diffused fuscous discal spot. Under-side : light brown suffused with fuscous ; diffused fuscous postmedial and sub-terminal bands on both wings, the postmedial on fore-wing strongly incurved.

♀. Darker than ♂, a whitish space between the sub-terminal

lines on hind-wings; on under-side the postmedial bands on both wings are followed by diffused white.

Expanse ♂ 84 mm., ♀ 112 mm.

Hab. Castro, Paraná.

Heliconisa satanas.

♂. Head antennæ thorax and abdomen dark fuscous; a few scattered reddish-brown hairs on legs and ventral surface of abdomen. Fore-wings dark fuscous suffused with reddish-brown especially on the costal region and in the cell; an indistinct black antemedial line, incurved and diffused in the cell; very wavy postmedial and sub-terminal lines enclosing broad fawn-coloured band suffused with fuscous strongly angled inwards below vein 2, scalloped above 2 and 3; very broad and paler, without suffusion, between 4 and 6 nearly reaching cell, then very narrow to apex; a large black spot surrounds discocellulars which are, with base of vein 5, fawn-colour; terminal area very dark suffused with olive-brown between the veins. Hind-wings fuscous; a broad medial brown shade very obscure except on costa where it forms a distinct patch; terminal area black. Under-side: fuscous, the yellow bands broader and more orange than on upper-side, on hind-wings much more distinct than upper-side.

Expanse 105 mm.

Hab. Castro, Paraná.

Family DALCERIDÆ.

Dalcera variegata.

♂. Palpi ochreous; head and antennæ grey; legs ochreous; tarsi white, claws black; thorax golden-yellow; tegulæ and patagia brown; abdomen golden-yellow above, pale ochreous beneath. Fore-wings yellow, outer half suffused with brown, very dark at termen; a curved wavy antemedial line; a brown spot in the cell; an orange line bordered by black on discocellulars followed by yellow space; a large and a small yellow space at apex. Hind-wings orange-yellow; terminal area and outer margin broadly black. Under-side: fore-wings yellow; outer half black with two yellow spots at apex. Hind-wings yellow, broadly black on terminal area.

Expanse 23 mm.

Hab. Castro, Paraná.

IX. Hymenoptera aculeata *collected in Algeria by the* Rev. A. E. Eaton, M.A., F.E.S., *and the* Rev. Francis David Morice, M.A., F.E.S. (Part I. Heterogyna, Fossores (pars) Trans. Ent. Soc., 1901, pt. iv, pp. 515–563. Part II. Diploptera, Fossores, 1905, part iv, pp. 399–417.) Part III. Anthophila. By Edward Saunders, F.R.S. etc.

[Read March 4th, 1908.]

Colletes spectabilis, Moraw.

♀ 1. Constantine, visiting *Thapsia garganica*, 15, v, 95. (*A. E. E.*)
♀ 1. Philippeville, 21, vi, 98. (*F. D. M.*)

Colletes coriandri, Perez.

♂ 1. Biskra, Route des Ziban, 25, ii, 94. (*A. E. E.*)
♂ 2. „ near the river by the brick-kiln beyond the Fort St. Germain, 4, ii, 95. (*A. E. E.*)
♀ 1. „ northern slope of the rocky ridge backing on the north of the Montagne de Sable, visiting *Retama retam*, Webb, 15, ii, 95. (*A. E. E.*)
♀ 1. „ near Old Biskra, on *Peridercа fuscata*, 9, ii, 94. (*A. E. E.*)

Dr. Longstaff took this species in some numbers at El Outaia, near Biskra, on *Spergula* flowers, March 1905, and one specimen at Biskra on *Euphorbia guyoniana*.

Colletes nanus, Friese.

♂ 1, ♀ 1. Biskra, near railway, Kilom. 199, visiting *Zizyphus lotus*, 29, iv and 3, v, 95. (*A. E. E.*)
♂ 1. „ a little above the barrage on or amongst *Tamarix*, 1, v, 97. (*A. E. E.*)

Colletes pumilus, Morice.

♂ 4, ♀ 1. Biskra, 7–10, v, 98. (*F. D. M.*)

Colletes eatoni, Morice.

♀ 1. Biskra, cornlands bordering the Route des Ziban leading to the Dunes, on *Ammi visnaga*, 25, v, 93. (*A. E. E.*)

♀ 1. Biskra, fields between the Negro village and Château Landon on *Ammi visnaga*, 9–10.30 a.m., 3, vi, 93. (*A. E. E.*)
♂ 3, ♀ 7. „ on *Tamarix*, 28, iv to 1, v, 97. (*A. E. E.*)

Colletes ligatus, Er.

♀ 1. Biskra, near railway, Kilom. 199, on *Zizyphus lotus*, 3, v, 95. (*A. E. E.*)
♀ 2. Médéa, slopes of the Nador up to 3,300 feet, 8 to 10.30 a.m., 14, vii, 93. (*A. E. E.*)
♂ 1, ♀ 3. La Calle, near the cemetery, 4 and 8, vii, 96. (*A. E. E.*)

Colletes balteatus, Nyl.

♀ 3. Médéa, on *Daucus setifolius*, 30, vii and 2, viii, 93. (*A. E. E.*)
♀ 1. Biskra, near the Col de Sfa, on flowers of *Deverra scoparia*, 26, xi, 94. (*A. E. E.*)
♂ 1, ♀ 1. Bône, 10 and 30, viii, 97. (*A. E. E.*)
♀. Philippeville, 21, vi, 98. (*F. D. M.*)

Colletes picistigma, Thoms.

♂ 1. Azazga, 30, viii, 93. (*A. E. E.*)

Colletes succinctus, L.

♂ 2, ♀ 1. Constantine, on *Inula viscosa*, 9, x and 4, xi, 93. (*A. E. E.*)
♀ 2. Bône, on *Erica multiflora*, 28, xi, 93. (*A. E. E.*)
♀ 1. Constantine, Djebel Ouach, near the reservoirs, alt. 3,000 feet, visiting low compositæ, 11, x, 94. (*A. E. E.*)
♂ 1. Constantine, 2, vi, 95. (*A. E. E.*)

Colletes acutus, Per.

♂ 1. Constantine, on *Inula viscosa*, 15, x, 95. (*A. E. E.*)
♂ 4. Bône, on *Senecio leucanthemifolius*, 4 and 6, iii, 96. (*A. E. E.*)
♂ 1, ♀ 2. Algiers, 23, iv, 98. (*F. D. M.*)

Dr. Longstaff took this species at flowers of *Spergula*, 1, iii, 05, and with it two specimens of *C. braeatus*, Per., not included otherwise in this list.

Prosopis cornuta, Smith.

♂ 4, ♀ 2. Le Tarf, on *Fœniculum vulgare* and *Ammi visnaga*, 25–27, vii, 96. (*A. E. E.*)

Prosopis dilatata, Kirb., var.?

♂ 1. Hippône, on *Ammi visnaga*, 15, viii, 96. (*A. E. E.*)
This specimen apparently differs only from *dilatata* in having the yellow colour more developed, it has the mandibles labrum and hind tibiæ entirely flavous, and has a small black spot on the intermediate tibiæ. The form of the scape of the antennæ, however, and the sculpture throughout appear to me to be identical with those of *dilatata*. In colour it more resembles *cervicornis*, Costa.

Prosopis spilota, Först.

♂ 2 (one stylopized), ♀ 2, Hippône, on *Ammi visnaga*, 15, viii, 96. (*A. E. E.*)
♂ 1. Le Tarf, on *Fœniculum vulgare*, 25, vii, 96. (*A. E. E.*)
♀ 1. „ on *Fœniculum vulgare*, 27, vii, 96. (*A. E. E.*)
♀ 1. „ on *Ammi visnaga*, 26, vii, 96. (*A. E. E.*)

These specimens again are slightly different from what we know here as *spilota*, and I have had very great doubts as to whether I should describe them as a new species or not, but I have decided against doing so. Of the three males one is stylopized so that its characters may have been altered by the effect of the parasite. The others differ from the typical form in having the mandibles and labrum pale. The female differs from the typical form in having the first segment of the abdomen more finely punctured, but the characters are not decided enough to satisfy me that the two forms are distinct.

Prosopis variegata, F.

Both sexes common, Constantine, Le Tarf, La Calle, Bône, Hippône, Médéa, Biskra, on *Ammi visnaga*, *Eryngium triquetrum*, *tricuspidatum*, *Thapsia garganica*, May to September. (*A. E. E.* and *F. D. M.*)

All the males in both collections are of the ordinary red-bodied type and nearly all the females have the clypeus with a white central line, but three females of the var.

absoluta were found by Mr. Eaton, at Médéa on *Eryngium triquetrum* and two at Constantine on *Eryngium triquetrum* and *Thapsia garganica*; also among his specimens are four females with broad red mesonotal stripes and two males with the propodeum posteriorly red; of these the two males and two of the females were taken at Hippône, the other two females at Biskra. In these highly-coloured females the central polished line of the posterior face of the propodeum is more or less red, but the colour does not spread over the rest of the surface as in the males.

Prosopis quartinæ, Grib.

♂ 5, ♀ 1. Biskra, near railway, Kilom. 199, at *Zizyphus lotus*, 30, iv to 3, v, 95. (*A. E. E.*)
♂ 9. „ on *Deverra chlorantha*, 10, 11 and 13, v, 97. (*A. E. E.*)
♀ 1. „ on *Ammi*, 21, v, 97. (*A. E. E.*)
♂ 2, ♀ 8. „ 20, v to 3, vi, 98. (*F. D. M.*)

Prosopis picta, Smith.

♂ 4, ♀ 3. Bône, on *Rubus discolor*, 11–13, viii, 97. (*A. E. E.*)

Prosopis gazagnieri, Vach.

♀. Biskra, ridge of hills and its spurs north-east of Hamman es Salahin, visiting *Ferula vesceritensis*, 5, iv, 95. (*A. E. E.*)
♀. „ visiting *Antirrhinum ramosissimum*, 21, iii, 97. (*A. E. E.*)
♂ ♀. Algiers, 11 and 23, iv, 98. (*F. D. M.*)
„ var. nigra, ♂ 10, ♀ 9, 31, iii to 27, iv, 98. (*F. D. M.*)

Prosopis purpurissata, Vach.

♂. Azazga, 1,900 feet, on *Eryngium triquetrum*, 12, ix, 93. (*A. E. E.*)
♂. „ Forêt de Yakouren, on *Eryngium triquetrum*, 19, ix, 93. (*A. E. E.*)
♂. Bône, 28, iv, 96.
♀. „ on *Mentha rotundifolia*, 6, viii, 96. (*A. E. E.*)
♂ 2, ♀ 2. Bône, on *Rubus discolor*, 11 and 12, viii, 97. (*A. E. E.*)

Prosopis purpurissata, black var. = *stigmorrhina*, Per.

♂ 1. Algiers, 28, iv, 98. (*F. D. M.*)
♀ 1. Constantine, 16, v, 98. (*F. D. M.*)

Prosopis gribodoi, Vach.

♂ 12, ♀ 5. Biskra, on *Tamarix*, 28, iii to 19, iv, 97. (*A. E. E.*)
♀ 2. „ on *Tamarix brachystylis*, 4, iv, 95. (*A. E. E.*)

Prosopis fertoni, Vach.

♂. Algiers, 8, iv, 98. (*F. D. M.*)
♀. Algiers, base of Bou-zaréa, near the Faubourg Bab-el-Oued, on a yellow *Linum*, 28, iv, 93. (*A. E. E.*)

Prosopis pilosula, Per.

♀. Biskra, ridge of hills and its spurs north-east of Hamman es Salahin, visits *Ferula vesceritensis*, 5, iv, 95. (*A. E. E.*)

Prosopis sulphuripes, Grib.

♂. Algiers, on the ramparts, on *Reseda*, 9, iii, 93. (*A. E. E.*)
♂. Hussein Dey, on the banks of the main road, 4, iv, 93. (*A. E. E.*)
♀. Biskra, near the Col de Sfa, on flowers of *Deverra scoparia*, 26, xi, 94. (*A. E. E.*)
♀. Le Tarf, on *Ammi visnaga*, 26, vii, 96. (*A. E. E.*)
♂. Algiers, 8 and 14, iv, 98. (*F. D. M.*)

Prosopis clypearis, Schk.

♂ 2, ♀ 1. Azazga and Yakouren, on *Eryngium tricuspidatum*, alt. 1,900 feet, and 19, ix, 93. (*A. E. E.*)
♂ 2. Bône, on *Ammi majus* and *Daucus*, 8, viii, 96. (*A. E. E.*)
♂ 1. „ on *Daucus gracilis*, 13, viii, 97. (*A. E. E.*)
♀. Near Algiers, on *Magydaris tomentosa*, 5, v, 93. (*A. E. E.*)
♀ 9. Le Tarf, on *Fœniculum vulgare*, 25 to 27, vii, 96. (*A. E. E.*)
♀ 6. Hippône, on *Ammi visnaga*, 10 and 15, viii, 96. (*A. E. E.*)

♀ 1. Bône, on *Sedum cærulcum*, 14, v, 96. (*A. E. E.*)
♀ 1. Constantine, 11, x, 94. (*A. E. E.*)

Prosopis dubitata, Alfk.

♂ 1. Le Tarf, on *Fœniculum vulgare*, 24, vii, 96. (*A. E. E.*)
♀ 1. Hippône, on *Ammi visnaga*, 15, viii, 96. (*A. E. E.*)

Prosopis pictipes, Nyl.

♂ 1. Bône, on *Eryngium tricuspidatum*, 6, viii, 96. (*A. E. E.*)

Prosopis brevicornis, Nyl.

♀ 1. Hippône, on *Ammi visnaga*, 12, viii, 96 and 1, viii, 97. (*A. E. E.*)
♂ 1. Algiers, on *Magydaris tomentosa*, 5, v, 93. (*A. E. E.*)
♂ 1. Le Tarf, on *Ammi visnaga*, 26, vii, 96. (*A. E. E.*)
♂ 1. Bône, on *Daucus gummifer*, 17, viii, 96. (*A. E. E.*)
♂ 1. „ visiting *Rubus discolor*, 11, viii, 97. (*A. E. E.*)
♀ 1. Le Tarf, on *Umbelliferæ*, 27, vi, 96. (*A. E. E.*)

Sphecodes fuscipennis, Germ.

♂ 2. Médéa, Ravines near Md. Ben Omar, alt. 3,130–2730 ft., on *Eryngium triquetrum*, 11, vii, 93. (*A. E. E.*)
♂ 1. Biskra, on *Ammi visnaga*, 24, v. 97. (*A. E. E.*)
♂ 1. Bône, on *Eryngium tricuspidatum*, 6, viii, 96. (*A. E. E.*)
♀ 1. Médéa near Damiette, on *Eryngium triquetrum*, 5, vii, 93. (*A. E. E.*)
♀ 1. „ on *Mentha rotundifolia*, 19, vii, 93. (*A. E. E.*)
♀ 1. near Médéa, on *Daucus setifolius*, 30, vii, 93. (*A. E. E.*)
♂ ♀. Algiers, 17, iii, and 22, iv, 98. (*F. D. M.*)
♀. Constantine, 30, x, 94. (*A. E. E.*)

All the specimens contained in the collections are of the variety with red tibiæ.

Sphecodes gibbus, L.

♂ 4, ♀ 1. Biskra, on *Ammi visnaga*, 18 and 24, v, 93 and 23, v, 97. (*A. E. E.*)
♂. Médéa, on *Eryngium triquetrum*, 28, vi, 93. (*A. E. E.*)

Sphecodes reticulatus, Thoms.

♂ 2. Hippône on *Ammi visnaga*, 12 and 15, viii, 96. (*A. E. E.*)
♀ 2. Bône 1, v, 96. (*A. E. E.*)
♀ 4. Biskra, 1, iv and 10, v, 97. (*A. E. E.*)

All the specimens of the above two species have red tibiæ and entirely red abdomen.

Sphecodes ruficornis, Sich.

♂ ♀. Biskra, on the north side of the ridge beyond Beni Mora, on *Ammi visnaga*, 30, v, 97. (*A. E. E.*)

Sphecodes ruficornis, Sich. var.

♂. Biskra cornlands, bordering the route des Ziban, on *Ammi visnaga*, 18, v, 93. (*A. E. E.*)
♂ 7, ♀ 1. Biskra, on *Ammi visnaga*, 15 to 30, v, 97. (*A. E. E.*)

These specimens are rather smaller than the above, the thorax is entirely black, and the antennæ and femora nearly so. They all, however, have the pale tegulæ which separates them from the other species with the exception of *rufithorax*, Mor.

Sphecodes rufithorax, Mor.

♂ 2. Biskra, on *Ammi visnaga*, 8, vii, 97. (*A. E. E.*)
♀ 1. „ 9, v, 98. (*F. D. M.*)

Sphecodes atrohirtus, Per.

♂ 2. Hippône, 10, iii, 96. (*A. E. E.*)
♀ 2. Biskra, 24, iii, 94 and 3, iii, 97. (*A. E. E.*)
♂ 2, ♀ 3. Algiers, 18, iii to 29, iv, 98. (*F. D. M.*)

Sphecodes puncticeps, Thoms.

♂ 8, ♀ 1. Le Tarf, on *Fœniculum vulgare*, 24 to 27, vii, 96. (*A. E. E.*)

Sphecodes pilifrons, Thoms.

♀ 2. Bône, 7 and 23, iii, 96. (*A. E. E.*)

Sphecodes, sp. ?

♀ 1. Biskra, 4, iv, 97. (*A. E. E.*)

Halictus formosus, Dours.

♂ 1. Biskra, cornlands bordering the Route des Ziban, on *Ammi visnaga*, Lam., 18, v, 93. (*A. E. E.*)
♀ 1. „ near old Turkish Fort, near the Barrage Oued Biskra, on *Ammi visnaga*, 30, v, 93. (*A. E. E.*)
♀ 1. „ between Beni Mora and the road to Fontaine Chaude, on *Ammi visnaga*, 28, v, 94. (*A. E. E.*)
♀ 2. „ on *Amberboa lippii*, 8 and 11, iv, 97. (*A. E. E.*)
♀ 1. „ on *Echinops spinosus*, 8, v, 97. (*A. E. E.*)
♀ 2. „ on *Ammi visnaga*, 28 and 31, v, 97. (*A. E. E.*)

Halictus, 4-cinctus, Fab.

♂ 4. Between Médéa and Lodi, on *Centaurea calcitrapa*, 5 to 14, vii, 93. (*A. E. E.*)
♂ 1, ♀ 2. Médéa, on *Mentha rotundifolia*, 4 to 19, vii, 93. (*A. E. E.*)
♂ 2, ♀ 1. Le Tarf, on *Cynara cardunculus*, 23 and 24, vii, 96. (*A. E. E.*)
♀ 1. Constantine, on *Carduus macrocephalus*, 18, v, 95. (*A. E. E.*)
♀ 1. Aine Draham, on *Centaurea* sp., 21, vii, 96. (*A. E. E.*)

Halictus scabiosæ, Rossi.

♂ ♀. from numerous localities and very variable in size, visiting *Ammi visnaga*, *Calamintha*, *Inula viscosa*, *Centaurea nicæensis*, and *calcitrapa*, *Scabiosa maritima*, *Onopordon macracanthum*, *Cynara cardunculus*, *Scolymus hispanicus*, *Tamarix*, *Mentha rotundifolia*. (*A. E. E.* and *F. D. M.*)

Halictus, sp. ?

♂ 1. Bône, on *Eryngium* 3-*cuspidatum*, 6, viii, 96. (*A. E. E.*)

Halictus vaulogeri, Per.

♀ 1. Médéa, Route d'Alger, on *Centaurea nicæensis* and *Scabiosa maritima*, 26, vi, 93. (*A. E. E.*)
♀ 1. Between Médéa and Lodi, on *Centaurea calcitrapa* 12, vii, 93. (*A. E. E.*)

Halictus albarius, Per.

♀ 1. Biskra, between railway, Kilom. 199 and the River, on *Amberboa lippii* D.C., 8, iv, 94. (*A. E. E.*)

Halictus albicinctus, Luc.

♀ 1. Bouzaréa, Algiers, 28, iv, 93. (*A. E. E.*)
♀ 1. Biskra, on *Ammi visnaga*, 28, v, 94. (*A. E. E.*)
♀ 3. „ 28, v, 94 and 8, iv, 97. (*A. E. E.*)

Halictus clavipes, Drs.

♂. Biskra, 14, v, 98. (*F. D. M.*)
♂ 3. Algiers, iii and iv, 98. (*F. D. M.*)
♀ 1. Constantine on M'cid, 22, v, 95. (*A. E. E.*)

Halictus separandus, Frey, G.

♂ 1. Tizi Ouzou, on *Calamintha*, 15, vi, 93. (*A. E. E.*)
♂ 2. Le Tarf, on *Cynara cardunculus*, 24, vii, 96. (*A. E. E.*)

Halictus platycestus, Dours.?

♂ 1. Bône, 12, viii, 97. (*A. E. E.*)

Halictus callizonius, Per.

♂ 2, ♀ 2. Biskra, on *Ammi visnaga*, 17 and 24, v, 93. (*A. E. E.*)
♂ 2. „ on *Tamarix*, 29, iv, 97. (*A. E. E.*)
♂ 2. „ on *Carduus*, 7, v and 18, v, 97. (*A. E. E.*)
♂ 1. Bône, 19, vii, 97. (*A. E. E.*)
♂ 1. Médéa, on *Centaurea calcitrapa*, 11, vii, 93. (*A. E. E.*)
♂ 2. La Calle, 9, vii, 96. (*A. E. E.*)
♀ 1. Biskra, on a sandy footpath, 16, iv, 94. (*A. E. E.*)
♀ 2. Bône, one on *Crepis taraxascifolia*, 20, iv and 1, v, 96. (*A. E. E.*)

Halictus femoralis, n. sp.

♀. Niger, facie elongata, capite thoraceque dense punctatis, propodeo truncato, area basali vermiculato, postice sub-rotundato. Abdomine nitido, sat dense punctato, segmentis 2, 3, 4, basi albido fasciatis, tibiis tarsisque intermediis et posticis etiam que femoribus posticis læte testaceis.

Deep black, face elongate, densely punctured, sparsely clothed with pale brownish hairs, considerably narrowed towards the apex, clypeus shining with very large scattered punctures, projecting for its entire length beyond the eyes, mesonotum punctured and clothed like the vertex, tegulæ brown, wings slightly dusky, post scutellum densely clothed with short ochreous pubescence, propodeal area vermiculately rugose bounded by a slightly raised line, abdomen elongate elliptic, shining, rather strongly punctured, depressions wide, but punctured like the rest of the segments, margins scarcely discoloured, the 2nd, 3rd and 4th segments having a well defined entire band of ochreous-white pubescence at the base, 5th segment with golden red pubescence at the apex and along the margins of the rima; intermediate tibiæ and tarsi and posterior legs with the exception of the coxæ and trochanters entirely clear testaceous.

Long. 10 mm.

♀ 2. Mechta-el-arbi, on *Cichorium intybus*, 16, v, 93. (*A. E. E.*)

This very distinct species is apparently allied to those of the *scxnotatulus* group.

Halictus, sp. ?

♀ 1. Bône, 25, v, 96. (*A. E. E.*)

Halictus interruptus, Pz.

♂ 3, ♀ 4. Médéa, on *Centaurea calcitrapa*, 12, vii, 93. (*A. E. E.*)

♀ 12. Biskra, visiting *Ammi visnaga, Peganum harmala, Traganum nudatum, Amberboa lippii, Zizyphus lotus, Ferula vesceritensis, Thapsia garganica, Antirrhinum ramosissimum.* (*A. E. E.*)

Halictus, sp. ?

Coloration of albipes ♂, but face much shorter, wings slightly dusky, ♂ of *bimaculatus* ?

♂ 1. Bône, 10, vi, 96. (*A. E. E.*)

♂ 1. La Calle, 1, vii, 96. (*A. E. E.*)

Halictus vergilianus, Per.

♂ 2. Biskra, in the Jardin by Fort St. Germain on a tree with blue flowers, 26, v, 93. (*A. E. E.*)

HALICTUS CINCTICORNIS, n. sp.

♂. Valde elongatus, griseo pubescens, antennarum articulis 4–13 basi apiceque griseo cingulatis. Capite thoraceque punctatissimis. Abdomine cylindrico, minutissime ruguloso et punctato, segmentis ventralibus 2 et 3 disco albido hirsutis. ♀. *Malachuro* simillima propodeo breviori, apice latiori, abdomine ægre punctato, maculis segmenti secundi majoribus, distinguenda.

♂. Very elongate, black, labrum, apex of the clypeus and mandibles except at the extreme base, tibiæ and tarsi except a spot on the anterior and posterior sides of the former flavous, each segment of the abdomen with a pale apical ring. Head and thorax exceedingly closely, finely and rugosely punctured, lateral angles of the cheeks above the mandibles viewed from in front somewhat prominent, face elongate much as in *albipes*, clothed in front with white, on the vertex with greyish ochreous hairs, antennæ long, joints 4 to 13 with a well marked grey pubescent basal and apical band, that of the apex very narrow on the more basal joints, hardly perceptible on 5. Mesonotum punctured and clothed like the vertex of the head, tegulæ very pale testaceous, wings hyaline, nerves testaceous, legs clothed with whitish hairs, knees tibiæ and tarsi pale, the tibiæ with a black anterior and posterior streak, propodeum with a sub-triangular and finely longitudinally rugose area, subtruncate posteriorly but with its angles rounded, entire thorax clothed with greyish hairs, sides of the propodeum very finely and diagonally striate; abdomen very elongate clothed with fine short grey hairs, exceedingly finely and closely punctured, even more so than in *malachurus* and quite distinct in this respect from *albipes* or *cylindricus*; 2nd and 3rd segments with a rather large but ill-defined lateral patch of white pubescence on each side of the base, all the segments with a rather broad pale semitransparent apical ring, 2nd and 3rd ventral segments clothed on the disc with projecting white hairs.

♀ Resembling that sex of *malachurus* but with the clypeus more produced giving the face a longer shape, and with an almost imperceptible puncturation on the basal segment of the abdomen, the surface of this segment under a Coddington lens is seen to be exceedingly finely aciculate with a very fine and rather scattered puncturation, in *malachurus* the puncturation is fine and very close. The propodeum in the species here described is shorter and wider at the apex than in *malachurus*, and the white patches of hairs at the base of the 2nd segment much more developed, the entire abdomen also is much less hairy.

Long. 8–9 mm.

♂ 1. Médéa, Ravines near Md. Ben Omar, on *Eryngium triquetrum*, *Scabiosa maritima* and *Microlonchus salmanticus*, 11, vii, 93. (*A. E. E.*)
♂ 1. La Calle, 1, vii, 96. (*A. E. E.*)
♀ 1. Médéa, on *Allium*, 14, viii, 93. (*A. E. E.*)
♀ 1. La Calle, 1, vii, 96. (*A. E. E.*)

I sent a ♂ and ♀ of this species to Prof. Perez who kindly returned it as allied to *albipes*.

Halictus malachurus, K.

♂ ♀ common, Algiers, Constantine, Médéa.
Le Tarf, Hippône. (*A. E. E.*)
♂ 17, vii to 15, viii—♀ 14, ii to 28, v.
♂ on *Verbena officinalis*, *Fœniculum vulgare* and *Ammi visnaga*.
♀ on *Thapsia garganica* and *Sedum cæruleum*.

Halictus bimaculatus, Dours.

♀ 2. Bône, 24, ii and 15, iii, 96. (*A. E. E.*)

I am indebted to Prof. Perez for this identification.

Halictus capitalis, Per.

♀ 3. Algiers and Hussein Dey, burrowing in the bank of the main road, 4, iv, 93. (*A. E. E.*)
♀ 1. Algiers, base of Bouzaréa, on *Phagnalon rupestre*, 28, iv, 93. (*A. E. E.*)
♀ 1. Bône, 24, ii, 96. (*A. E. E.*)

I am indebted to Prof. Perez for this identification.

Halictus, sp.?

♀ 1. Constantine, on *Alsine procumbens*, 15, vi, 94. (*A. E. E.*)

Small species near *capitalis*, but propodeum less truncate.

Halictus articularis, Per.

♀ 1. Biskra, Col de Sfa, on *Deverra scoparia*, 26, xi, 94. (*A. E. E.*)
♀ 1. „ ridge of hills N.E. of Hamman es Salahin, on *Ferula vesceritensis*, 5, iv. 95. (*A. E. E.*)

Halictus ventralis, Per.

♂ 1. Médéa, Gorges de la Chiffa, alt. 700–800 ft., on *Mentha rotundifolia* and *Verbena officinalis*, 26, vii, 93. (*A. E. E.*)
♂ 2. Médéa, on *Sonchus arvensis*, 28, vii, 93. (*A. E. E.*)
♂ 3. Constantine, "at burrows in a sandy bank," 15, x, 95. (*A. E. E.*)
♀ 1. Biskra, 3, iv, 97. (*A. E. E.*)
♀ 1. Bône, 26, iii, 96. (*A. E. E.*)

Halictus, sp.?

♀ 1. Biskra, 17, v, 93. (*A. E. E.*)

A species peculiar in having a fine central carina on the anterior disc of the mesonotum and unusually long ventral brushes, longer than in *villosulus*, etc. (*A. E. E.*)

Halictus mediterraneus, Per. MS.

♂ 2, ♀ 19. Biskra, ♂ April — ♀ February and March; ♀ visiting *Zygophyllum cornutum*, *Moricandia arvensis*, *Brassica napus*, *Cleome arabica*, *Retana retam*, *Ferula vesceritensis*. (*A. E. E.*)

Halictus, sp.?

♀ 1. Biskra, 1, iii, 97. (*A. E. E.*)
Allied to above.

Halictus breviceps, E. Saund.

♂ 2. Le Tarf, on *Fœniculum vulgare*, 24, vii, 96. (*A. E. E.*)
♀ 1. „ on *Daucus muricatus*, 17, vi, 96. (*A. E. E.*)

Halictus villosulus, K.

♂ 2, ♀ 2. Médéa, on *Verbena officinalis*, 17, vii, 93. (*A. E. E.*)
♂ 4. Hippône, on *Chondrilla juncea*, 22, viii, 96. (*A. E. E.*)
♀ 2. Sidi Ferruch, 8, v, 93. (*A. E. E.*)
♀ 1. Bône, on *Crepis clausonis*, 31, xii, 95. (*A. E. E.*)
♀ 1. „ on *Senecio leucanthemifolius*, 15, iii, 96. (*A. E. E.*)
♀ 2. Biskra, on *Ammi visnaga*, 17, v, 93; 27, v, 97. (*A. E. E.*)

♀ 1. Biskra, on *Sonchus maritimus*, 12, iv, 97. (*A. E. E.*)
♀ 1. Constantine, on *Sonchus tenerrimus*, 8, v, 95.
♀ 1. „ „ „ „ 2, xi, 94. (*A. E. E.*)

Halictus punctatissimus, Schk.

♀ 1. Azazga, 2, ix, 93. (*A. E. E.*)
♀ 1. Bône, 2, iii, 96. (*A. E. E.*)

Halictus yakourensis, sp. nov.

♂. Niger nitidus, clypei apice, mandibulis, antennis subtus, tegulis, tibiis anterioribus antice, tarsis genubusque omnibus plus minus piceis, genis subprominentibus angulosis, mesonoto punctato, interstitiis lævibus, abdomine subovali, nitido, punctato. Segmentorum apicibus vix impressis.

Black, apex of clypeus, mandibles, antennæ beneath, tegulæ, front tibiæ anteriorly and all the tarsi more or less piceous; head finely and closely punctured above the insertion of the antennæ, less closely so on the clypeus. Cheeks short, slightly projecting laterally between the eyes and mandibles in a sharp angle; mesonotum shining, regularly and somewhat closely punctured, intervals between the punctures smooth, wings slightly dusky, post-scutellum hairy, legs clothed with short whitish hairs, 2nd and 3rd joints of hind tarsi slightly longer than wide, propodeum not truncate posteriorly, basal area rather small, irregularly striate, sides punctured and clothed with short greyish hairs, abdomen shining elongate ovate, with scattered greyish-white hairs, which are more abundant towards the apex, apical impressions of the segments scarcely indicated except at the sides, 1st segment rather sparsely punctured, the following more closely so, nearly smooth at their apices; beneath somewhat shining very finely rugulose and remotely punctured the punctures bearing fine hairs.

Long. 6 mm.

♂ 4. Forêt de Yakouren, on and over the ridge on which stands the Maison Forestier, on *Eryngium tricuspidatum*, 19, ix, 93. (*A. E. E.*)

This species is very distinct by its angulated cheeks and deep black colour.

Halictus, sp. ?

♀ 1. Bône, 1, v, 96. (*A. E. E.*)

HALICTUS, HOLLANDI, E. Saund.

♂ 1. Médéa, Gorges de la Chiffa, on *Mentha rotundifolia* or *Verbena officinalis*, 26, vii, 93. (*A. E. E.*)
♀ 1. Bône, 26, iii, 96. (*A. E. E.*)

HALICTUS AGLYPHUS, Per.

♀ 1. Bône, visiting *Salsola kali*, 23, viii, 97. (*A. E. E.*)
♀ 1. Constantine, on *Thapsia garganica*, 17, v, 95. (*A. E. E.*)
♀ 2. Biskra, on *Ammi visnaga*, 30, v, 93 to 28, v, 97. (*A. E. E.*)

One example has the abdomen testaceous as described by Perez, another piceous-brown, a third nearly black.

HALICTUS STRICTIFRONS, Vach.

♂ 1. Biskra, 10, iv, 97. (*A. E. E.*)
♀ 3. Bône, burrows into the vertical face of the river-bank, 30, iv, 96. (*A. E. E.*)

HALICTUS SPHECODIMORPHUS, Vach. ♂?

♂ 1. Tizi Ouzou, on *Zizyphus lotus*, 14, vi, 93. (*A. E. E.*)

I submitted this specimen to Mons. Vachal, and am indebted to him for the suggestion that it may be the ♂ of his species.

HALICTUS SOROR, E. Saund.

♂ 1. Algiers, on *Chrysanthemum segetum*, 28, iv, 93. (*A. E. E.*)
♂ 2, ♀ 1. Constantine, on *Ecballium elaterium*, 30, ix, 93. (*A. E. E.*)
♂ 1 ♀ „ on *Sedum cæruleum*, 13, v and 16, 95. (*A. E. E.*)
♀ 1. „ on *Hypochæris glabra*, 13, v, 95. (*A. E. E.*)
♂ 1. Bône, 14, v, 96. (*A. E. E.*)
♂ 2. La Calle, 1 and 24, vii, 96. (*A. E. E.*)
♂ 1. Algiers, on *Phagnalon rupestre*, 28, iv, 93. (*A. E. E.*)
♀ 1. „ 24, ii, 93. (*A. E. E.*)
♀ 1. Bône, on *Salsola kali*, 3, viii, 97. (*A. E. E.*)
♀ 1. Hippône, 8, iv, 96. (*A. E. E.*)

Halictus morio, Fab.

♂ 1. Constantine, on *Ecballium elaterium*, 30, ix, 93. (*A. E. E.*)
♀ 3. Algiers, 5 and 19, iv, 98. (*F. D. M.*)

Halictus simulans, Per.

♂ 1, ♀ 1. Bône, sandy ground skirting the sea-shore beyond the Seybouse, visiting *Senecio leucanthemifolius*, 4, iii, 96. (*A. E. E.*)
♀ 1. Bône, 9, iv, 96. (*A. E. E.*)
♀ 1. Algiers, 29, iv, 98. (*F. D. M.*)

Halictus dives, Per.

♀ 3. Biskra, on *Ammi visnaga*, 17, 20 and 28, v, 97. (*A. E. E.*)

Halictus gemmeus, Dours.

♂ 2 ♀ Common: Constantine, Bône, Azazga, Le Tarf, Tizi Ouzou, Médéa, Hippône, visiting *Eryngium triquetrum, tricuspidatum, Solanum nigrum. Fœniculum vulgare, Onopordum macracanthum. Verbena officinalis, Mentha rotundifolia, Ecballium elaterium, Inula viscosa, Crepis clausonis, Salsola kali, Lotus ornithopodioides*, May to October. (*A. E. E.* and *F. D. M.*)

Halictus vestitus, Lep. var. pallidus, Grib.

♂ 1. Biskra, on *Tamarix*, 20, iv, 97. (*A. E. E.*)
♂ 1. „ on *Zizyphus lotus*. "Eyes in life iridescent vaguely streaked with bronzy-green and peacock-blue." 29, iv, 95. (*A. E. E.*)
♀ 4. „ on *Ammi visnaga*, 24, v, 93 and 27, v. 97. (*A. E. E.*)
♀ 1. „ on *Ferula vesceritensis*, 5, iv, 95. (*A. E. E.*)
♀ 1. „ on *Tamarix brachystylis*, 8, iv, 95. (*A. E. E.*)
♀ 1. „ on *Nitraria tridentata*, 11, v, 97. (*A. E. E.*)
♀ 1. „ on *Antirrhinum ramosissimum*, 21, iii, 97. (*A. E. E.*)
♀ 1 ?. Bône, on *Salsola kali* (much rubbed), 20, viii, 97.

Halictus, sp. ?

♀ 1. Médéa on *Asparagus officinalis*, 28, vi, 93. (*A. E. E.*)

Halictus mucoreus, Ev.

♂ 6. Biskra, on *Ammi visnaga*, 17 and 28, v, 97 and 8, vii, 97. (*A. E. E.*)
♀ 4. „ on *Ammi visnaga*, 17, iv to 29, v, 97. (*A. E. E.*)
♀ 1. „ on *Amberboa lippii*.
"Eyes in life indistinctly streaked with bronze-green and peacock-blue." 11, iv, 95. (*A. E. E.*)
♀ 1. „ visiting *Peganum harmala*, 12, iv, 95. (*A. E. E.*)
♀ 2. „ on *Limoniastrum guyonianum*, 27, iv, 95 and 6, v, 97. (*A. E. E.*)
♀ 2. Médéa, on *Centaurea calcitrapa*, 12 to 21, vii, 93. (*A. E. E.*)
♀ 1. „ on *Mentha rotundifolia*, 11, viii, 93. (*A. E. E.*)

Andrena flessæ, Pz.

♀ 1. Algiers, Colonne Voirol, 4, v, 93. (*A. E. E.*)
♀ 1. Bône, on *Euphorbia helioscopia*, 4, v, 96. (*A. E. E.*)
♂ 2. Constantine, on *Ferula communis*, 14, v. 95. (*A.E.E.*)
♂ 2, ♀ 1. „ visiting *Rapistrum rugosum* and *Diplotaxis muralis*, 22, v. 95. (*A. E. E.*)
♀ 2. Biskra, on *Moricandia arvensis*, 10, iii and 14, iv, 94. (*A. E. E.*)
♀ 1. „ on *Diplotaxis*, 11, ii, 97. (*A. E. E.*)
♀ 1. „ on *Brassica napus*, 27, ii, 97. (*A. E. E.*)

Andrena asperrima, Per.

♂ 1. Biskra, on *Ammi visnaga*, 28, v, 94. (*A. E. E.*)

Andrena ephippium, Spin.

var. entirely black.
♂ 1. Biskra, claybank of the Oued, 26, ii, 94. (*A. E. E.*)
♂ 1. „ 19, iv, 95. (*A. E. E.*)
♀ 1. „ on *Moricandia fuscata* and *arvensis*, 10, iii, 94. (*A. E. E.*)
var. with red thorax.
♀ 1. Biskra, visiting *Moricandia arvensis*, 25, iii, 95. (*A. E. E.*)
♀ 1. „ on *Ammi visnaga*, 29, v. 94. (*A. E. E.*)
♀ 2. „ 12, ii and 26, iii, 97. (*A. E. E.*)

Dr. Longstaff took the ♂ of this species at flowers of *Euphorbia guyoniana* and *Spergula sp.* February and March 1905.

ANDRENA PILIPES, Fab.

♂ 1. Hippône, 10, iii, 96. (*A. E. E.*)
♀ 1. Le Tarf, on *Centaurea napifolia*, 27, vi, 96. (*A. E. E.*)

ANDRENA MORIO, Brullé.

var. entirely black.
♀ 1. Biskra, on *Ammi visnaga*, 24, v. 93. (*A. E. E.*)
♀ 1. Médéa, on *Eryngium triquetrum*, 27, vi, 93. (*A. E. E.*)
♀ 1. Biskra, 26, iii, 97. (*A. E. E.*)
var. collaris.
♂ 1. Biskra, on *Ammi visnaga*, 25, v. 93. (*A. E. E.*)
♂ 1. La Calle, 8, vii, 96. (*A. E. E.*)
♂ 1. Biskra, visiting *Atractylis serratuloides*, 6, v, 97. (*A. E. E.*)
♀ 1. Fontaine Chaude, on *Euphorbia guyoniana*, 17, iii, 94. (*A. E. E.*)
♀ 1. Biskra, 3, iv, 97. (*A. E. E.*)
♀ 1. Médéa, on *Eryngium triquetrum*, 11, vii, 93. (*A. E. E.*)
♀ 1. Biskra, on *Ammi visnaga*, 25, v. 93.
A curious specimen with red femora and red propodeal area. (*A. E. E.*)

ANDRENA FUNEBRIS, Pz..

♀ 1. Biskra, near the conduit and mill-stream between Fort St. Germain and the railway, 5.15 to 6.45 a.m., on *Ammi visnaga*, 17, v, 93. (*A. E. E.*)
♀ 1. Médéa, near Damiette, on *Onopordon macracanthum*, 5, vii, 93. (*A. E. E.*)
♀ 1. Biskra, Route d'Alger, on *Centaurea nicæensis*, and *Scabiosa maritima*, 26, vi, 93. (*A. E. E.*)
♀ 1. (stylopized.) Constantine, on Meçid, 23, v, 94. (*A. E. E.*)

ANDRENA BIMACULATA, K.

♀ 2. Biskra, on *Peridercea fuscata*, 8, ii, 94 and 2, v, 97. (*A. E. E.*)
♂ 1, ♀ 4. „ on *Tamarix*, 14, v, 94 and 28 and 29, iv, 95. (*A. E. E.*)

ANDRENA THORACICA, F.

♀ 2. Médéa, on *Eryngium triquetrum*, 27, vi, 93. (*A. E. E.*)
♀ 2. Bône, 2 and 16, iii, 96. (*A. E. E.*)
♀ 1. „ visiting *Senecio leucanthemifolius*, 4, iii, 96 (*A. E. E.*) (very dark red hairs on the thorax).

ANDRENA NIGRA, n. sp.

♀. Nigra, tarsis omnibus tibiisque posticis obscure testaceis, area propodeali sub-lævigata, alis infumatis, abdomine minute ruguloso remote punctato, segmentorum apicibus testaceis.

♀. Black, clothed with black hairs, those on the sides of the propodeum and of the thorax below the wings slightly greyish, all the tarsi and the tibiæ of the hind-legs when the light passes through them seem to be testaceous, calcaria pale, in form and size resembling *rosæ*, Pz. Antennæ with the 2nd joint of the flagellum rather longer than the 3rd and 4th taken together, clypeus finely rugulose and strongly punctured. Head and thorax including the propodeum densely clothed with black hairs, those of the propodeum and vertex longer than those of the thorax ; propodeal area nearly smooth, wings smoky-brown, abdomen very finely rugulose with a fine scattered superficial puncturation, apices of the segments testaceous, in certain lights the abdomen seems to have a very slight bluish tinge, apical fimbria black, dorsal valve closely punctured, its margins smooth ; beneath punctured, the segments with black apical fringes.

Long. 12 mm.

♀ 1. Bône, visiting *Diplotaxis*, 30, iv, 96. (*A. E. E.*)

Rather like a black *rosæ* r. *trimmerana* in general form, but its sculpture and the comparative lengths of the antennal joints will distinguish it easily.

ANDRENA BIPARTITA, Brullé.

♂ 3, ♀ 4. Biskra on *Diplotaxis* and *Moricandia arvensis*, 3, ii to 30, iii, 97. (*A. E. E.*)

ANDRENA FLOREA, F.

♀ 1. Colonne Voirol, on *Bryonia*, 5, v, 93. (*A. E. E.*)
♀ 1. Hippône, 16, v, 96. (*A. E. E.*)
♀ 1. Algiers, 4, iv, 98. (*F. D. M.*)

ANDRENA LEUCOPHÆA, Luc.

♂ 2, ♀ 2. Algiers, 17 to 28, iii, 98. (*F. D. M.*)

Andrena derivata, Perez.

♂ 2 ♀. Bugeaud, alt. 2,750 feet, on *Senecio leucanthemifolius*, 17, ii, 96. (*A. E. E.*)
♀ 3. Bône, on *Senecio leucanthemifolius*, 15, ii and 6, iii, 96. (*A. E. E.*)
♀ 2. Algiers, 17, ii and 9, iii, 93. (*A. E. E.*)

Andrena rosæ, Pz.

race Trimmerana.

♂ 2. Colonne Voirol, on *Magydaris tomentosa*, 5, v, 93. (*A. E. E.*)
♀ Algiers, 9, iv, 89. (*F. D. M.*)

Dr. Longstaff took it at Biskra, on flowers of *Euphorbia guyoniana*, 7, iii, 05. (*A. E. E.*)

Andrena nigroænea, K.

♂ 1, ♀ 1. Biskra, on *Ammi visnaga*, 15, v, 97 and 25, ii, 94. (*A. E. E.*)
♀ 3. Algiers, 29, iii to 19, iv, 98. (*F. D. M.*)

Dr. Longstaff took this species on *Retama retam*, at Biskra, 26, ii, 95; on *Spergula* sp. at El Ontaia, 1, iii, 05, and on *Euphorbia guyoniana* in Kabylia, 18, iii, 05.

Andrena hirticornis, Per.

♂ 1. Algiers, iii, 98. (*F. D. M.*)

Andrena gwynana, K.

♂ 1, ♀ 2. Constantine, on *Ferula communis*, 10 and 14, v, 95. (*A. E. E.*)
♀ 1. Algiers, 17, ii, 93. (*A. E. E.*)
♀ 1. El Biar, on *Compositæ*, 20, iii, 93. (*A. E. E.*)

Andrena testaceipes, n. sp.

Nigra fulvopilosa, antennarum articulo tertio, duobus sequentibus simul sumptis longiore, abdomine testaceo basi, maculâ dorsali segmenti secundi, apicibusque segmentorum sequentium nigris fimbriâ anali aureâ, tibiis tarsis-que læte testaceis, aureo-hirtis.

♀. Black. Head and thorax clothed with pale brownish hairs, those of the scutellum and post-scutellum of a brighter fulvous tint. Abdomen with the apices of the segments widely, and a large patch on each side of the 2nd segment and a smaller one on each side of the third testaceous, apical fimbria golden, legs with the hind tibiæ

and all the tarsi clear testaceous-yellow, scopæ golden. Clypeus finely rugulose, punctured, face above the antennæ striate, antennæ with the 2nd joint of the flagellum longer than the next two together but not so long as the next three, 3rd and 4th transverse, 5th slightly longer than the 4th, the rest subquadrate. Mesonotum finely rugulose but slightly shining, finely punctured. Wings with a yellowish tinge, nervures testaceous, propodeum finely rugulose with rather close and shallow and very large punctures, abdomen shining very finely and somewhat remotely punctured, segments beneath fringed with ochreous golden hairs.

Long. 9 mm.

♀ 2. Constantine, on *Sonchus tenerrimus*, 20, v and 1, vi, 95. (*A. E. E.*)

ANDRENA TUBERCULIFERA, Per.

♀ 1. Le Tarf, 24, vi, 96. (*A. E. E.*)
♀ 1. Bône, on *Diplotaxis*, 6, iv, 96. (*A. E. E.*)
♂ 1, ♀ 1. Algiers, 18, iv and 18, iii, 98. (*F. D. M.*)

ANDRENA ALBOCINEREA, n. sp.

♂. Niger, albohirtus, antennarum articulo 4^to^ et sequentibus subquadratis, 3^to^, 4^to^ et dimidio quinti subæquali. Mesothorace opaco, punctato, abdominis segmentis basi punctatis apicibus impressis nitidis, segmento basali pilis longis suberectis, reliquis pilis brevibus adpressis vestitis.

♂. Black, clothed with long white hairs, those near the orbits of the eyes of a slightly sooty colour, and those of the mesonotum with a greyish tinge, wings hyaline, nervures pale testaceous. Clypeus so densely clothed with snowy-white hairs that its sculpture and form are invisible but regarded anteriorly, with the insect upside-down it is seen to be semicircularly emarginate, and the labrum bears a transverse emarginate tubercle. Antennæ rather short, the 2nd joint of the flagellum almost as long as the 3rd and ½ of the 4th together, those from the third upwards subquadrate, if anything appearing a little longer than wide, mesonotum dull, finely and rather closely punctured, the punctures distant from each other 3 or 4 of their own diameters, the sculpture, however, is exceedingly difficult to see as the hairing is so dense ; legs sparingly clothed with white hairs, propodeal area finely rugulose, abdomen shining, 1st segment sparsely clothed with long erect white hairs those of the following short and semi-adpressed, 2nd and following segments closely and finely punctured at the base, their apices widely impressed

and very shining, the extreme base of the impressions finely and remotely punctured, the apices slightly discoloured, and of a somewhat bronzy-brown colour, apical fimbria brownish-golden, segments beneath clothed with very long hairs, eighth ventral segment subtruncate, its stem densely fringed towards the apex with long hairs, making a fan-shaped expansion, regarded sideways slightly elbowed, armature with rather elongate straight stipites, their basal angles only slightly produced.

Long. 9–10 mm.

♂ 7. Biskra, near the dunes and on the left of the Route de Tougourt, on *Periderea fuscata*, 8, ii, 94 and 25, i, 95. (*A. E. E.*)

In appearance closely resembling the ♂ of *nycthemera* and of *florentina*, but the shorter antennæ and very different armature distinguish it at once from the former and the white hairs and the absence of black velvety pubescence at the base of the abdominal segments from the latter.

Andrena florentina, Magr.

♂ 3. Bône, 21, i, 16 and 24, ii, 96. (*A. E. E.*)

I am indebted to Professor Perez for this information.

Andrena albohirta, n. sp.

♂. Niger, dense albido hirsutus, antennarum flagello, abdominis segmentorum apicibus, tarsorum apicibus venisque alarum testaceis, abdomine ruguloso, opaco.

Black, entirely covered with whitish hairs, erect on the head and thorax and more or less adpressed towards the apex of the abdomen, apices of the segments, the flagellum of the antennæ beyond the 2nd joint, the nervures of the wings and the apices of the tarsi pale testaceous. Second joint of the flagellum as long as the 3rd and 4th taken together, 3rd much longer than the 2nd. Mesonotum shining, but so hidden by the hairs that its surface is hardly visible, abdomen as seen between the hairs finely rugulose, the apices of the segments bearing a dense apical band of white hairs, apical fimbria ochreous, abdomen beneath with bright golden apical fringes, 8th ventral valve slightly widened at the apex, subtruncate, its stem rather narrow, with a fringe of short hairs along the sides, armature with the lobes produced into very strong teeth. I communicated this species to Professor Perez, who returned it to me as allied to his *A. farinosa*.

Long. 7–8 lines.

♂ 4. Biskra, on the high flat-topped ridge beyond Gaddecha, on *Zygophyllum cornutum*, 10 and 12, ii, 94. (*A. E. E.*)
♂ 1. „ 5, ii, 97. (*A. E. E.*)

ANDRENA, sp. ? (*stylopized*).

♂ 1. Algeria, 28, iii, 07. (*F. D. M.*)

ANDRENA FLAVIPES, Per.

♂ 1, ♀ 2. Bône, 21, i and 9 to 17, iii, 96. (*A. E. E.*)
♀ 1. Constantine, sandy banks, 17, iv, 94. (*A. E. E.*)

ANDRENA CREBERRIMA, Per.

♀ 1. Biskra, on *Amberboa lippii*, 8, iv, 97. (*A. E. E.*)

ANDRENA, n. sp.

♀ 1. Constantine, visiting *Œnanthe fistulosa*, 10, v, 95. (*A. E. E.*)

Apparently very distinct by the strongly punctured bases and deeply impressed apices of the segments which bear lateral fringes of white hairs, but from a single ♀ I refrain from describing it.

ANDRENA MEGACEPHALA, Sm.

♂ 1. Bône, behind the Kasbah, 15, iii, 96. (*A. E. E.*)
♀ 1. Biskra, 1, iii, 97. (*A. E. E.*)

ANDRENA BUCEPHALA, Steph.

♂ 1. Bône, 16, iii, 96. (*A. E. E.*)
♂ 1. Algiers, 18, iv, 98. (*A. E. E.*)

ANDRENA, sp. ? near BUCEPHALA.

♂ 1. Biskra, 1, iii, 97. (*A. E. E.*)

This ♂ is somewhat worn and therefore not in a condition to be described.

ANDRENA STRICTA, n. sp.

Rosæ var. *trimmeranæ* colore similis, sed angustior, abdomine opaco, antennarum articulo tertio duobus sequentibus simul sumptis maris duplo feminæ triplo longiore abdominis segmentis primo et secundo rufo-fusco hirtis, quarto et sequentibus nigro-hirsutis; pedibus gracilibus, scopis breviter hirsutis.

Like *Rosæ r. trimmerana* in colour but narrower and in form more resembling the ♀ of *bucephala*, and evidently belonging to that group by the form of the antennæ. I thought at first it was identical with *macilenta*, Perez, but of that species the author says, "abdomen très luisant" whereas in this species it is duller than in *rosæ*. The 2nd joint of the flagellum in the male is about equal in length to the following 2 together, in the ♀ about as long as the following 3. The rest of the joints slightly longer than broad in the ♂, distinctly so in the ♀, hairs of the face in the ♂ brown margined with black, in the ♀ black throughout, thorax clothed with bright brown hairs those of the sides paler, propodeal area very finely sculptured its margins slightly shining, abdomen narrow, not wider than the thorax in the ♀, nearly dull, finely rugulose with a remote puncturation which recalls that of the *humilis* group; 1st and 2nd segments sparingly clothed with long brown hairs, apices of the segments narrowly discoloured, the 2nd and 3rd in fresh examples with an apical fringe of brown hairs; 4th, 5th, and 6th segments clothed with black hairs, hind tibiæ very narrow, scopæ very small. Process of 8th segment in the ♂ rather short and wide, sharply elbowed near the base, its apex truncate, and its sides fringed with hairs which are shorter towards the apex, armature with its lobes slightly produced in front.

Long. 10–12 mm.

♀ 1. Constantine, 21, v, 95. (*A. E. E.*)
♀ 1. Bône, 2, iii, 96. (*A. E. E.*)
♂ 27, ♀ 4. Algiers, 15, iii and 21, iv, 98. (*F. D. M.*)

ANDRENA, sp. ? (*schmiedeknechti affinis*).

♀ 1. Algiers, 14, iv, 98. (*F. D. M.*)

This specimen is closely allied to *schmiedeknechti* but has the 3rd and following segments clothed with black hairs, in this respect it more closely resembles *nigrifrons*, Smith, but lacks the pale bands at the apices of the 2nd, 3rd, and 4th segments; as I do not feel sure that it may not be a colour variety of one or other of these closely allied species I refrain from describing it.

ANDRENA NIGRO-OLIVACEA, Drs.

♂ 1. Bône, visiting *Crepis clausonis*, 31, xii, 95. (*A. E. E.*)
♂ 1. Algiers, 14, iv, 95. (*F. D. M.*)
♀ 5. „ 19 and 31, iii, 98. (*F. D. M.*)

ANDRENA LIVENS, Per.

♂ 1, ♀ 1. Constantine, visiting *Crepis taraxascifolia*, 21, v, 95. (*A. E. E.*)

ANDRENA SENECIONIS, Per.

♂ 1. Algiers, on *Asteriscus maritimus*, 17, iv, 93. (*A. E. E.*)
♂ 2. Bône, 23, iii and 7, iv, 96. (*A. E. E.*)
♀ 1. Algiers, 14, iv, 98. (*F. D. M.*)

ANDRENA CURTIVALVIS, Morice.

♂ 1, ♀ 9. Algiers, 24, iii and 6, iv, 98. (*F. D. M.*)

ANDRENA GIRAUDI, Drs.

♂ 1. Algiers, 14, iv, 98. (*F. D. M.*)

ANDRENA MOLESTA, Per.

♂ 1. Algiers, 31, iii, 98. (*F. D. M.*)

ANDRENA, sp. (? *imminuta*, Per.)

♂ 1. Algiers, 18, iii, 98. (*F. D. M.*)

ANDRENA DOURSIANA, Duf.

♂ 1. Algiers, 16, iii, 98. (*F. D. M.*)

Agrees well with Dours' description of the ♂ of this species, the clypeus shows no sign of a spine such as characterises *mucronata*, Mor., and *fuscoprasina*, Per.

ANDRENA, n. sp. ?

♂ 1. Algiers, 17, iii, 98. (*F. D. M.*)

In colour and sculpture resembling the above exactly, but with very much shorter antennæ, the joints of which are only a trifle longer than wide, it must also be closely allied to *fuscoprasina*, Per., but the clypeus, which is white throughout, lacks the black spine. From a single specimen taken on the same day and together with *doursiana* I think it is wiser not to name it.

ANDRENA FERRUGINEICRUS, Drs.

♂ 3. Biskra, on *Peridercа fuscata*, 21, ii, 95. (*A. E. E.*)
♀ 3. „ on *Moricandia cinerea*, 16 and 17, ii, 94. (*A. E. E.*)
♂ 5. „ on *Brassica napus*, 27, ii, 97. (*A. E. E.*)

ANDRENA, sp. ? (*an prec. dist ?*)

♀ 1. Biskra, on *Brassica napus*, 27, ii, 97. (*A. E. E.*)

ANDRENA, sp. ?

♂ 1. Constantine, 13, vi, 98. (*F. D. M.*)

ANDRENA CIRCINATA, Drs.

♂ 3. Algiers, 13, iii to 11, iv, 98. (*F. D. M.*)
♂ 7. Bouira, 2, v, 98. (*F. D. M.*)

ANDRENA, sp. ?

♂ 1. Algiers, 30, iv, 98. (*F. D. M.*)

Apparently allied to the above but much more shining and with a very large and deeply punctate abdomen the segments of which are convex, and have apical bands of rather long ochraceous hairs, that of the 2nd and 3rd segments interrupted, that of the first only showing at the sides; antennæ rather short, 2nd joint of flagellum about twice as long as the third, the rest subquadrate. Head thorax and legs clothed with ochreous hairs.

ANDRENA RUFIVENTRIS, Lep.

♂ 8. El Guerrah, 3, v. 98. (*F. D. M.*)
♀ 1. Constantine, 13, vi, 98. (*F. D. M.*)

ANDRENA, sp. ?

♀ 1. Algiers, 27, iv, 98. (*F. D. M.*)

Resembling *distincta*, Luc. in general appearance but with the abdomen more shining and much more finely punctured, the punctures so fine as to be only observable under a strong lens.

ANDRENA LEUCOLIPPA, Per.

♂ 1. Algiers, on *Asteriscus maritimus*, 28, iv, 93. (*A. E. E.*)
♂ 4. „ 27 and 30, iv, 98. (*F. D. M.*)

ANDRENA BELLIDIS, Per.

♂ 1. Constantine, on *Anacyclus clavatus*, 10, v, 95. (*A. E. E.*)
♀ 1. „ 10, vi, 95. (*A. E. E.*)
♂ 7, ♀ 2. El Guerrah, 3, v, 98. (*F. D. M.*)

ANDRENA MICROTHORAX, Per.

♀ 1. Biskra, on *Moricandia cinerea*, 16, ii, 94. (*A. E. E.*)
♀ 1. „ on *Moricandia arvensis*, 10, ii, 97. (*A. E. E.*)
♀ 1. „ „ „ 1, iii, 97. (*A. E. E.*)

ANDRENA, sp. ?

♀ 1. Biskra, 12, iv, 97. (*A. E. E.*)

Abdomen densely clothed with adpressed pale hairs.

ANDRENA NIGROCYANEA, n. sp.

Nigra, abdomine cyaneo tincto, maris clypeo albo, nigro bipunctato, vertice striato, flagelli articulo secundo maris tertio quartoque simul sumptis fere æquali, feminæ paullo longiore, abdomine nitido segmentis 2–4 apice albo fasciatis fimbria anali aureâ. Scopis albidis.

♂ ♀. Black, head and thorax clothed with greyish-white hairs, clypeus of ♂ white with two little black discal spots, face of that sex densely clothed with long white hairs, abdomen with the posterior margins of the segments testaceous, 2nd and following segments with lateral fringes of white hairs in the ♂, with well-defined white bands in the ♀, apical fimbria pale golden, scopæ white, calcaria and apices of the tarsi pale.

♂. Clypeus punctured vertex and face above the antennæ striate antennæ with the 2nd joint of the flagellum scarcely so long as the 3rd and 4th together, the 4th longer than the 3rd and like the remainder of the joints subquadrate: mesonotum slightly shining finely rugulose and somewhat remotely punctured, wings slightly clouded, nervures brown, propodeal area ill-defined, slightly crenate at the extreme base, and rather smoother than its surroundings which are finely rugulose and hairy; abdomen shining, especially the basal segment, with a slight tinge of bronziness or blue in some lights, 2nd and following segments with very narrow lateral bands, microscopically rugulose and very finely punctured, apical margins slightly impressed and smoother, beneath punctured on the apical portions of the segments, ventral valve elongate, slightly widened and subtruncate at the apex, armature with the basal angles of the stipites largely rounded, the blades of the stipites very concave, sagittæ much swollen at the base.

♀. Differs from the ♂ in the ordinary sexual characters and also in having the 2nd joint of the flagellum longer than the 3rd and 4th together, the scutellum more shining than the mesoscutum and with only a very few punctures, in sharp contrast with the more closely

punctured portion of the mesoscutum above it, propodeal area scarcely indicated, very finely rugulose, abdomen sculptured much as in the ♂, but the rugulosities rather stronger, and there is scarcely any indication of metallic reflections, white bands of the segments well defined that of the second interrupted, segments beneath with very long rather dense fringes.

Long. 8 mm.

♂ 2. Biskra, on *Periderea fuscata*, 8, ii, 84. (*A. E. E.*)
♂ 1, ♀ 1. ,, on *Brassica napus*, 27, ii, 97. (*A. E. E.*)

ANDRENA VARIABILIS, Sm.

♂ 1. Between Médéa and Lodi, on *Centaurea calcitrapa*, 11, vii, 93. (*A. E. E.*)
♀ 1. Lodi, on *Eryngium triquetrum* (stylopized), 13, vii, 93. (*A. E. E.*)

ANDRENA LABIALIS ?

♂ 1. Algiers, 13, iv, 93. (*A. E. E.*)

ANDRENA, sp. ? (*stylopized*).

♀ 1. Biskra, 24, v, 93. (*A. E. E.*)

ANDRENA RHYSSONOTA, Per.

♀ 1. Sidi Ferruch, on *Magydaris tomentosa*, 8, v, 93. (*A. E. E.*)

ANDRENA FORCIPATA, n. sp.

♂. Niger albido-pilosus, opacus, remote punctatus, antennarum articulo tertio tribus sequentibus simul sumptis parum longiore, abdominis segmentis, apice late impressis; forcipum exteriorum lobis antice carinato-reflexis bene distinguendus.

♂. Large, about the size of and somewhat resembling *hattorfiana* and *nobilis*, black, clypeus and cheeks at its side yellow, the former with 2 small black discal spots, antennæ with the 2nd joint of the flagellum as long as the following 3 together the rest subquadrate, head and thorax rather densely clothed with grey hairs which have a slightly ochreous tinge on the mesonotum, dull, finely rugulose and with a very fine remote puncturation, wings with a smoky tinge as they approach the apex, nervures dark brown, propodeum rugulose, its basal area very finely and regularly so, with an impressed dorsal line. Abdomen nearly dull, finely rugulose, and remotely and finely punctured, the segments widely impressed

and slightly discoloured at the apex, clothed sparingly with rather long greyish hairs, the 3rd, 4th and 5th also with a slight lateral fringe, segments beneath finely aciculate their margins with fringes of rather long white hairs. 8th ventral segment subtriangular at the base, produced into a somewhat short, parallel-sided, apical process, hardly widened at the extreme apex which is truncato-emarginate, sides fringed with golden hairs. Armature of very unusual form, the lobes of the stipites being very large and their anterior margins strongly reflexed laterally, the blades are scarcely longer than the lobes, narrow and deeply channelled along the sides, sagittæ narrow and pointed.

Long. 13 mm.

♂ 2. El Guerrah, 3, v, 98. (*F. D. M.*)

This species is most like *nobilis*, Mor., but the shorter antennæ and the proportionately longer 2nd joint of the flagellum as well as the form of the armature will distinguish it easily.

ANDRENA MERIMNA, n. sp.

Nigra, subopacae, vertic striato, antennarum articulo tertio in utroque sexu tribus sequentibus simul sumptis æquali abdomine minute ruguloso segmentorum apicibus albo fimbriatis fascia segmenti basalis late interrupta fimbria anali aureo fusca, scopis albidis.

A rather obscure-looking species but one which I fail to find described, it somewhat resembles a very large member of the *minutula* group with entire abdominal bands.

♂. Black, head and thorax clothed with greyish-white hairs, clypeus shining strongly and remotely punctured the surface between the punctures finely rugulose with traces of longitudinal striæ, face above the antennæ striate, 2nd joint of the flagellum as long as the next 3 together, 3rd and 4th slightly wider than long, rest of the joints subquadrate; mesonotum finely rugulose with a superficial remote puncturation, its hairs inclining to ochraceous in colour, propodeal area rugulose: abdomen finely rugulose, somewhat shining, sparingly clothed with semierect white hairs those towards the sides and on the first two segments longest, apices of the segments discoloured, 2nd and following with a rather thin fringe-like band of white hairs, these bands more developed at the sides and on the apical segments, beneath with the apices fringed with very long hairs, apical ventral valve narrow, slightly dilated and entire at the apex fringed with long golden hairs in a fan-like

form, armature dark brown. Teeth at the base of the stipites wide and well developed, extreme apex of the apical dilatation of each stipes slightly emarginate, sagittæ much inflated at the base, testaceous-brown.

♀. Very like the ♂, clypeus duller and more clearly striate. 2nd joint of the flagellum as in the ♂ about equal in length to the next 3 taken together, mesonotum dull and finely rugose with a very fine and remote superficial puncturation, abdomen rather narrow, sculptured as in the ♂ but the bands of the segments much more conspicuous, the basal segment also having white hairs at the sides, apical fimbria brown.

Long. 8–9 mm.

Biskra, ♂ 1, ♀ 1, on *Moricandia arvensis*, ♂ 11, ii, 94 and ♀ 3, ii, 97. (*A. E. E.*)

ANDRENA NIVEOZONATA, n. sp.

Nigra, nitida, capite thoraceque albido hirsutis, abdominis apicibus segmentorum læte albo fasciatis fimbria anali aureâ. ♂. Antennarum articulis tertio, quarto quintoque subæqualibus, ♀ articulo tertio, quarto quintoque simul sumptis longiore.

Black, head and thorax clothed with whitish hairs, abdomen very shining, segments with very clearly defined white apical bands, nervures of the wings pale testaceous, the tarsi testaceous in the ♂.

♂. Face densely clothed with snowy-white hairs, vertex striate, antennæ with the 2nd, 3rd and 4th joints of the flagellum subequal, slightly longer than wide, mesonotum shining, finely and remotely punctured, clothed with nearly white hairs which have however a slight ochreous tinge, propodeal area rather more shining than its surroundings, abdomen shining finely and remotely punctured, the apices of the segments slightly discoloured and bearing a narrow well-defined band of white hairs—legs clothed with white hairs.

♀. Face clothed with white hairs, clypeus closely and largely punctured, antennæ testaceous towards the apex, with the 2nd joint of the flagellum longer than the following 2 together, vertex striated, mesonotum very shining, remotely punctured clothed with almost white hairs having only a very slight ochreous tinge, propodeum dull, its basal area slightly shining and very finely rugulose; abdomen deep black, finely punctured and very shining, the first 4 segments each bearing a rather broad, well defined band of snow-white hairs, the 5th and sides of the 6th more or less golden, beneath finely punctured the segments with somewhat inconspicuous apical fimbriæ, legs clothed with white hairs.

Long. 6–8 mm.

♂ 2, ♀ 1. Biskra, 9, iii, 95 and 6, iv, 97. (*A. E. E.*)
♀ 1. „ visiting *Tamarix brachystylis*, 4, iv, 95. (*A. E. E.*)

This species belongs, I should say, to the *argentata* group.

ANDRENA RUBROSIGNATA, n. sp.

♂. Niger, abdomine macula magna dorsali testacea ornato, antennarum articulus tertius quarto duplo longior, mesonotum lævе, punctatum, abdomen nitidum, segmentis secundo tertioque apice fimbria laterali, quarto fimbria completa aureis ornatis.

♂. Head and thorax black, antennæ beneath testaceous, abdomen with the centres of the 2nd and 3rd segments and the apex of the 1st testaceous, and there is also occasionally a testaceous line down the centre of the 1st; hind tibiæ except a stain on their anterior and posterior faces, and all the tarsi pale testaceous. Clypeus closely punctured, face clothed with pale ochreous hairs, 2nd joint of the flagellum twice as long as the 3rd, 3rd much shorter than the 4th which like the following joints is subquadrate, face above the antennæ striate; mesonotum smooth, shining, punctured, clothed rather sparingly with ochreous hairs, wings slightly brownish, propodeum slightly shining, finely and indefinitely rugose, abdomen shining, finely punctured, with very short lateral fringes of pale ochreous hairs on the 2nd and 3rd segments and an entire fringe on the 4th, apical fimbria pale golden, legs clothed with ochreous hairs. Long. 8 mm.

♂ 2. Constantine, hovering over and alighting on a footpath, 15, v, 95. (*A. E. E.*)
♂ 5. „ 13 to 17, vi, 08. (*F. D. M.*)

This species of which only the ♂ has been sent home rather resembles *lucens*, Imh., but the smooth surface of the thorax which in *lucens* is finely rugulose, will distinguish it at once, as well as the red-coloured disc of the abdomen.

ANDRENA LUCENS, Imh.

♂ 7, ♀ 6. Algiers, 17, iii to 30, iv, 08. (*F. D. M.*)

ANDRENA, n. sp.?

♂ 2. Algiers, 29, iii to 9, iv, 98. (*F. D. M.*)

A species apparently so closely allied to the preceding that I refrain from describing it on one sex only. One of the specimens

is in very fine condition and the thorax is more densely clothed with longer and brighter brown hairs than in *lucens*, and its sculpture is coarser giving it a duller appearance. The form of the 7th ventral segment also is different, viewed sideways in this species it is straight, in *lucens* it is elbowed.

ANDRENA MAYETI, Per.

♀ 4. Biskra, on *Ammi visnaga*, 18, v, 93 and 28 and 29, v, 94. (*A. E. E.*)
♀ 2. „ 27, v and 2, vi, 98. (*F. D. M.*)

ANDRENA NIGRIVENTRIS, n. sp.

♀. Caput et thorax nigra, albido hirsuta, hirsutie supra subochracea, antennis subtus apiceque testaceis, articulo tertio, tribus sequentis simul sumptis subæquali, alis hyalinis, nervuris testaceis. Abdomen supra testaceum, apice nigro, subtus nigrum ; pedes nigri, tarsorum apicibus testaceis.

♀. Head and thorax black clothed with whitish hairs, those of the vertex and mesonotum slightly tinged with yellow, apex and underside of the antennæ pale testaceous, tegulæ pale, wings hyaline, nervures pale testaceous, abdomen above testaceous, its extreme base and the fifth segment black ; beneath with the 2nd and following segments black, legs black, calcaria and apices of the tarsi pale. Rather short and compact in form, face densely clothed with more or less decumbent white hairs, clypeus closely and rugosely punctured, labrum with a flat shining lamelliform tubercle, orbital furrows clothed with dense golden pubescence, antennæ with the 2nd joint of the flagellum nearly as long as the next 3 together, mesonotum very slightly shining closely punctured, propodeal area well defined, with a central sulcature which does not reach the apex, there is almost an indication of diagonal rugosities on each side of it, beyond the area the propodeum is very finely rugulose and punctured, abdomen finely and closely punctured, slightly shining, microscopically aciculate between the punctures, 2nd segment with a short band of white hairs on each side, 3rd and 4th with entire bands, anal fimbria whitish, golden at the extreme apex, segments beneath fringed with pale hairs, scopæ of tibiæ white.

Long. 9 mm.

♀ 1. Hamman es Salahin, on *Picridium vulgare*, 9, iv, 97. (*A. E. E.*)

ANDRENA MINUTULA, group of.

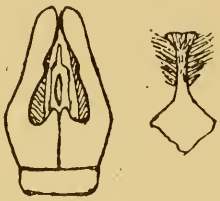
This exceedingly difficult section of the genus requires a complete revision, and as I have neither the material nor opportunity to prepare one I am obliged simply to indicate the number of forms contained in the collections and where possible to assign them to described species, where that is impossible I give the characters which I notice as belonging to each. I think when I explain the position in which this section now stands I shall not be accused of undue cowardice in hesitating to refer the more obscure species to any of the descriptions now extant. I have spent months over this group and feel sure that no satisfactory result can be obtained without having the type specimens of all the species under one's eye and providing a complete synopsis of them.

There are over 30 presumed species described, of which nearly half are known by one sex only (the ♀), in those where the ♂ is described I can find no allusion to the forms of the apical segments and armature. These give very reliable though in some cases slender characters, and without the help of these I have been unable even from the descriptions of celebrated Hymenopterists to determine my species. The sculpture of the clypeus and abdomen appears to me to be more or less variable although there seem to be definite types of sculpture which keep distinct notwithstanding the variations in each. Another difficulty arises as to the essential characters of the males. To examine these, unless they have been extracted when fresh, means to destroy more or less the specimen and to make a proper description of its external characters impossible. Mr. Morice, who collected a large number of males at Algiers, first pointed out to me several forms of armature amongst his captures and in dissecting my own taken by Mr. Eaton I find others. Of all these I propose to give diagrams as I think no description will satisfactorily point out the distinguishing characters. I had hoped that the relative proportions of joints 1, 2 and 3 of the flagellum might have afforded reliable characters, but they are so nearly the same in most of the species and appear to vary so in accordance with the position from which they are regarded that very little satisfactory evidence can be got from them.

Andrena minutula, K. (*parvula*).

♂ 1. Algiers, 24, ii, 93. (*A. E. E.*)
♂ 8. Biskra, on *Peridercafuscata*, 4 and 8, ii, 94 and 25, i, 95. (*A. E. E.*)
♂ 2. Biskra, 14, ii, 94. (*A. E. E.*)
♂ 1. „ on *Brassica napus*, 27, ii, 97. (*A. E. E.*)

Andrena trizona, Per.



♂ ♀ Bône, visiting *Koniga maritima*, 4, ii, 96. (*A. E. E.*)
♂ ♀ Bone, visiting *Senecio leucanthemifolius*, 4, iii, 96. (*A. E. E.*)
♂ 5, ♀ 1. Bône, 24, ii to 6, iii, 96. (*A. E. E.*)

Andrena varicornis, Per.

♂ 1. Biskra, on *Tamarix brachysylis*, 4, iv, 95. (*A. E. E.*)
♂ 1. „ on *Moricandia cinerea*, 16, ii, 94. (*A. E. E.*)
♀ 1. „ on *Moricandia arvensis*, 10, ii, 97. (*A. E. E.*)

Andrena schenkella, Per.

♀ 1. Constantine, visiting *Thapsia garganica*, 28, v, 95. (*A. E. E.*)
♂ 1, ♀ 4. Algiers. 14, iii, 98. (*F. D. M.*)

Andrena impunctata, Per.

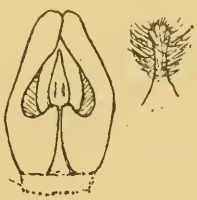
♀ 3. Biskra, on *Ammi visnaga*, 24, v, 93 and 5, vi, 97. (*A. E. E.*)
♀ 10. „ i. iv to 25, v, 98. (*F. D. M.*)

Andrena pusilla, Per.

♂ 1. Biskra, on *Peridercea fuscata*, 4, ii, 94. (*A. E. E.*)
♀ 2. Constantine, on *Diplotaxis muralis*, 9 and 22, v, 95. (*A. E. E.*)
♀ 2. Algiers, 23, ii, 93. (*A. E. E.*)
♀ 1. Biskra, on *Brassica napus*, 27, ii, 97. (*A. E. E.*)
♀ 1. „ on *Sonchus maritimus*, 12, iv, 97. (*A. E. E.*)
♀ 1. „ amongst *Tamarix*, 19, iv, 97. (*A. E. E.*)
♀ 15. Algiers, 14, iii to 27, iv, 98. (*F. D. M.*)

Andrena alpha.

This ♂ is peculiar in having the clypeus raised until just above the anterior margin, so that the rounded front edge of the elevation looks like the apex of the clypeus, it is very shining and remotely punctured. Antennæ dark testaceous beneath with the 2nd joint of the flagellum shorter than the 2 following together, 3rd shorter than the 4th, the rest rather longer than wide, slightly increasing in length towards the apex. Face vertex and cheeks clothed



with white hairs. Thorax clothed with white hairs. Mesonotum finely rugulose without evident punctures, propodeal area not clearly limited, finely rugulose. Abdomen finely rugulose slightly shining without definite puncturation, apical impressions well defined, rather narrow, very pale, smooth and less sculptured than the rest of the segments; segments 2, 3, and 4 with white but not very conspicuous lateral bands of hairs, tarsi except the metatarsi testaceous. In size slightly larger than *minutula*.

♂ 1. Biskra, river-bed, on *Moricandia arvensis*, 11, ii, 94. (*A. E. E.*)
♂ 1. „ on *Moricandia fuscata*, 10, iii, 94. (*A. E. E.*)

ANDRENA BETA.

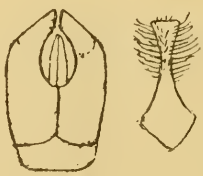
A slightly larger species than the preceding, face including the clypeus densely clothed with pale ochreous hairs, from what is visible of the clypeus between the hairs it appears to be very largely and closely punctured. Antennæ pale testaceous beneath, 2nd joint of the flagellum unusually short, the 3rd joint very wide and transverse which makes it look like a continuation of the 2nd, as it is quite as wide or possibly wider than that joint, 4th and following

joints nearly quadrate, the apical joints rather longer. Vertex clothed with pale hairs, thorax clothed with pale hairs. Mesonotum finely rugulose and slightly shining with a large scattered puncturation, propodeal area rugulose especially near its base; abdomen rather shining, finely rugulose, impressions narrow and deep, nearly smooth and much discoloured, sides of the segments with inconspicuous bands of whitish hairs; tarsi of all the legs pale.

♂ 1. Biskra, on *Reseda*, 12, ii, 97. (*A. E. E.*)

ANDRENA, GAMMA.

Another species with testaceous tarsi although these are darker than in either of the preceding. In size it is distinctly smaller.



The face is clothed with pale hairs, the clypeus is finely rugulose, punctured and somewhat shining, the antennæ have the 3rd and 4th

joints of the flagellum transverse and subequal, the 2nd being almost as long as the next 2 together, mesonotum finely rugulose without evident puncturation, propodeal area indefinite, very finely rugulose, abdomen finely rugulose somewhat shining, with a remote fine puncturation, apical impressions slightly indicated, sides of the segments with a thin white fringe very distinct from the other species with pale tarsi by the form of the armature.

♂ 1. Bône, 2, iii, 96. (*A. E. E.*)
♂ 3. Algiers, 17, iii, 98. (*F. D. M.*)

Andrena, sp.?

This may be the ♀ of either of the preceding, it is about the size of a large *minutula*, the clypeus is shining and finely and remotely punctured, finely striate or rugulose at the extreme base, thorax clothed with whitish hairs, finely rugulose, without evident punctures, propodeum very finely rugulose its area merely indicated by a narrow smoother line, the apical portion of the area slightly shining, abdomen very finely rugulose, the impressions only indicated at the sides and each segment rugulose up to its posterior margin which bears on each side a rather well-marked fringe of white hairs, that of the 4th segment forming an entire band; 5th in the centre and 6th at the sides with golden hairs; legs clothed with white hairs, scopæ white.

♀ 1. Biskra, visiting *Traganum undatum*, 13, iii, 97. (*A. E. E.*)

Andrena delta.

A species peculiar in the very, small size of the armature, face clothed with white hairs, clypeus largely punctured, shining, truncate in front, flagellum with the 2nd and 4th joints subequal, 3rd slightly shorter, rest rather longer than wide, mesonotum finely rugu-

lose and with a very fine scattered puncturation propodeal area finely rugose at the base, abdomen finely rugulose, with a fine puncturation among the rugosities, apical impressions well marked and sides of the segments with distinct white fringes.

♂ 1. Algiers, 30, iv, 98. (*F. D. M.*)

Andrena epsilon.

A small short species, head (including the vertex) and thorax clothed with pale hairs, clypeus rather shining with a remote irregular puncturation, antennæ brown beneath, 2nd joint of the flagellum only slightly longer than the 3rd, 3rd slightly shorter than 4th, the rest subquadrate appearing wider than long in some

positions, mesonotum finely rugulose and with a very scattered, fine puncturation, propodeal area indefinite, finely rugulose, abdomen short and elliptic, dull, rugulose, impressions strongly marked and rugulose like the rest of the segment, scarcely any indication of lateral fringes.

♂ 1. Médéa, Route d'Alger, 26, vi, 93. (*A. E. E.*)
♂ 1. „ Koudia Sma, on *Daucus carota*, 8, vii, 93. (*A. E. E.*)

Andrena zeta.

A species which closely resembles *nana* of Kirby in the puncturation of the abdomen. I thought at one time it might prove to be *abstersa*, Per., but it has not got an unusually convex abdomen neither is the appendix of the labrum unusually small as described by that author.

♂. With the hairs of the face and vertex pale, clypeus shining and largely punctured, 2nd joint of the flagellum rather longer than the 4th, 3rd slightly shorter than the 4th, the rest subquadrate, mesonotum rugulose, finely punctured, propodeal area very finely reticulate, abdomen shining, finely rugulose, with fine punctures among the rugulosities, the impressions deep, discoloured, and smoother than the rest of the segment, lateral fringes white.

♀. With the clypeus less shining than in the ♂, finely rugulose and largely punctured, mesonotum finely rugulose and finely punctured, abdomen slightly shining and rather closely but finely

punctured, the impressions wide, somewhat discoloured and smoother than the disc.

Of the same size as *minutula*.

Unfortunately I destroyed the armature of my only ♂ in dissecting it out.

♂ 1, ♀ 3. Constantine, on *Sedum cæruleum*, 13 and 16, v, 95. (*A. E. E.*)

♀ 1. „ on *Ferula communis*, 20, v, 95. (*A. E. E.*)

♀ 1. Algiers, 14, iii, 98. (*F. D. M.*)

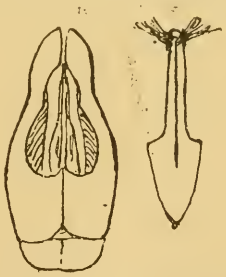
Andrena eta.

Very like the above in puncturation but with long brown hairs on the face in the region of the antennæ, these latter have 2nd and 4th joints subequal, and the 3rd shorter, the mesonotum exhibits no sign of puncturation and the abdominal fringes are unusually long and bright.

♂. Bône, 2, iii, 96. (*A. E. E.*)

Andrena theta.

A rather large ♂ with very long white hairs on the head and thorax, those of the face mixed with sooty-coloured hairs, clypeus rugulose and very strongly punctured, antennæ testaceous-brown beneath, 2nd joint of flagellum nearly as long as the 3rd and 4th together, 3rd slightly shorter than the 4th, the rest subquadrate



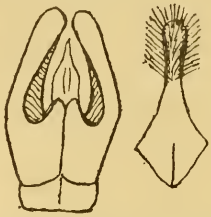
gradually increasing in length towards the apex. Mesonotum finely rugulose and with some scattered shallow punctures, propodeum finely rugulose its area scarcely determined, abdomen elongate, very finely rugulose with an exceedingly fine puncturation scattered among the rugulosities of the 2nd and following segments, apices of the segments slightly discoloured but scarcely impressed, the sculp-

ture like that of the disc but impunctate, lateral fringes very slightly indicated. A very well-marked species on account of the very unusual shape of the 8th ventral segment with its somewhat bottle-brush arrangement of hairs at the apex, and the very elongate armature.

♂ 1. El Biar, on *Compositæ*, 20, iii, 93. (*A. E. E.*)
♂ 3. Algiers, 13, iii to 7, iv, 98. (*F. D. M.*)

Andrena iota.

Slightly smaller than the preceding, head clothed with pale hairs clypeus shining, largely punctured, antennæ with the 2nd joint of the flagellum slightly shorter than the 3rd and 4th taken together, the 3rd not quite so long as the 4th, mesonotum dull, finely rugu-



lose, propodeal area finely rugulose, abdomen finely rugulose, impunctate, more or less shining, impressions discoloured, well marked at the sides, less sculptured than the rest of the segments, lateral fringes hardly noticeable. Exceedingly like *alpha* but clypeus built on a different plan not raised on the disc as in that species.

♂ 1. Constantine, visiting *Hypochæris glabra*, 14, v, 95. (*A. E. E.*)
♂ 20. Algiers, 15, iii to 9, iv, 98. (*F. D. M.*)

Andrena kappa.

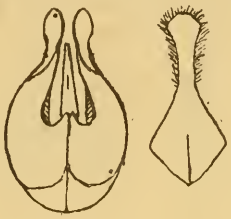
Almost identical with the preceding but differing in the slightly longer stipites of the armature and the very fine puncturation scattered amongst the rugosites of the abdomen.

♂ 1. Bône, 24, ii, 96. (*A. E. E.*)

Andrena lambda.

Head and thorax clothed with long whitish hairs, a few of those near the insertion of the antennæ more or less blackish, clypeus

rather shining, and strongly punctured, 2nd joint of the flagellum longer than the 4th, 3rd shorter than the 4th, mesonotum finely rugulose and with a fine remote, but distinct puncturation; propodeal area well defined, finely and somewhat clathrately rugose, its surroundings finely rugulose; abdomen shining, its rugulosities

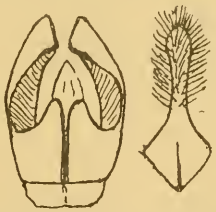


more superficial than in most of the forms, impressions well marked, sculptured much as the rest of the segment, slightly discoloured at the apex, armature very peculiar in the strongly incurved and narrow stipites; apparently a very distinct species, but in neither collection can I find any ♀ which looks likely to belong to it.

♂ 1. Bône, 1, v, 96. (*A. E. E.*)
♂ 15. Algiers, 15, iii to 9, iv, 98. (*F. D. M.*)

Andrena mu.

Head and thorax clothed with long whitish hairs, a few of those near the insertion of the antennæ blackish. 2nd joint of the flagellum slightly longer than the 4th, 3rd shorter, mesonotum finely rugulose with a distinct but remote puncturation, propodeal

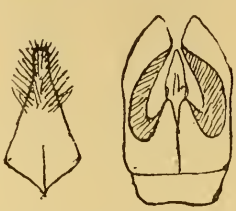


area scarcely defined, finely and reticulately rugose its surroundings almost equally rugose, abdomen dull the rugulosities very close and distinct, in some aspects looking almost like punctures, and a few well defined punctures are scattered amongst them, apical impressions of the segments not very strongly marked, rugulose like the disc.

♂ 3. Algiers, 28, iii, 98. (*F. D. M.*)

ANDRENA NU.

Head and thorax clothed with whitish hairs, those near the insertion of the antennæ mixed with darker ones, antennæ with the 2nd joint of the flagellum much longer than either the 3rd or 4th which are subequal and much wider than long. The following joints are all more or less transverse with the exception of the 11th



and 12th, mesonotum finely rugulose and with a distinct remote puncturation; propodeal area scarcely defined, very finely and not reticulately rugulose, in this respect similar to its surroundings, abdomen shining, very finely rugulose, and with a distinct very fine but not very distant puncturation, apices of the segments not discoloured, smoother than the discs, but scarcely impressed.

♂ 3. Algiers, 17, iii to 19, iv, 98. (*F. D. M.*)

This species closely resembles the former in the shape of the armature but is quite distinct in sculpture and in the very unusual, somewhat triangular, form of the 8th ventral segment.

ANDRENA, sp. ?

This ♀ may belong to the ♂ described above as it has the same finely rugulose propodeal area and a similarly sculptured abdomen; but from a single example amongst such closely allied forms, it is difficult to draw any satisfactory conclusion.

ANDRENA, sp. ? (*stylopized*).

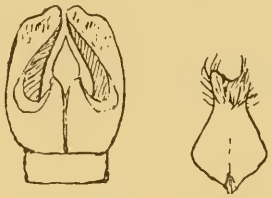
♀ 1. Algiers, 28, iv, 98. (*F. D. M.*)
♀ 2. Algiers, 14 and 24, iii, 98. (*F. D. M.*)

Being stylopized I have not endeavoured to refer these to any of the above species as their characters are liable to have been modified by the presence of the parasites.

ANDRENA OMICRON.

A short very rugose species easily distinguishable from any of the above.

♂. Head and thorax clothed with long white hairs, clypeus rugose, face and vertex vermiculately strigose, antennæ with 3rd and 4th joints of the flagellum subequal, rather wider than long, together rather longer than the 2nd; mesonotum dull, finely rugulose and strongly and somewhat remotely punctured, propodeum rugulose, clathrately so at the extreme base, abdomen short, elliptic, rugose and closely punctured, apical impressions strongly marked, finely rugulose, seventh ventral segment produced into



two strong processes each of which terminates in a tuft of pale hairs, 8th very wide produced at the apex into two angles with a wide sinus between them, the whole segment densely clothed with pale hairs.

♀ very closely resembling the ♂ even in form, 2nd joint of the flagellum rather longer than the two following taken together, mesonotum dull and rugulose rather closely punctured, propodeal area rather vermiculately rugose, abdomen sculptured as in the ♂ anal fimbria dull golden, scopæ whitish.

♂ 3, ♀ 4. Algiers, 16–31, iii, 98. (*F. D. M.*)

ANDRENA BISKRENSIS, Per.

♂ 5, ♀ 1. Biskra, 12, ii, 97. (*A. E. E.*)
♀ 3. „ on *Diplotaxis*, 11, ii, 97. (*A. E. E.*)
♂ 1, ♀ 3. „ on *Brassica napus*, 27, ii, 97. (*A. E. E.*)
1 ♀. „ *stylopized*, 10, ii, 97. (*A. E. E.*)

ANDRENA, sp. ?

1 ♀. Biskra, Fontaine Chaude sandhills, on *Euphorbia guyoniana*, 17, iii, 94. (*A. E. E.*)

A ♀ in not very good condition closely allied to the preceding.

ANDRENA HYPOPOLIA.

♀ 1. Biskra, on *Ammi visnaga*, 29, v, 94. (*A. E. E.*)
♀ 3. „ 10 to 23, v, 98. (*F. D. M.*)

Andrena propinqua, Schk.

♀ 1. Algiers, iii, 98. (*F. D. M.*)

Andrena tingitana, Per.

♂ 4, ♀ 1. Constantine, visiting *Œnanthe fistulosa*, 7 and 10, v, 95. (*A. E. E.*)

♀ 6. Le Tarf, on *Fœniculum vulgare* and *Ammi visnaga*, 24 and 26, vii, 96. (*A. E. E.*)

Andrena afzeliella, Kirb.

♂ 2. Constantine, 16, vi, 98. (*F. D. M.*)

♀ 1. Algiers, 31, iii, 98. (*F. D. M.*)

Andrena, sp.?

♀ 1. Biskra, visiting *Acanthyllis tragacanthoides*, 24, ii, 95. (*A. E. E.*)

Allied to the above and possibly a variety of it.

Biareolina neglecta, Drs.

♀ 1. Algiers, 9, iii, 93. (*A. E. E.*)

♀ 3. Bône, on *Senecio leucanthemifolius*, 15, ii, and 11, iii, 96. (*A. E. E.*)

1 ♂, 4 ♀. Algiers, 6–11, iv, 98. (*F. D. M.*)

Nomia latipes, Mor.

♂ 6, ♀ 2. Biskra, on *Ammi visnaga*, 26, v to 22, vi, 97. (*A. E. E.*)

♂ 1, ♀ 2. „ 20, v to 6, vi, 98. (*F. D. M.*)

Nomia ruficornis, L.

♂ 2. Biskra, Route des Ziban, on *Ammi visnaga*, 18, v, 93. (*A. E. E.*)

♀ 1. „ Col de Sfa, 27, v, 93. (*A. E. E.*)

♀ 2. „ rifle range beyond Beni Mora, 3 and 28, v, 94. (*A. E. E.*)

♀ 1. „ on *Moricandia arvensis*, 23, iv, 95. (*A. E. E.*)

♂ 5, ♀ 3. „ mostly on *Tamarix*, 9, iv to 15, v, 97. (*A. E. E.*)

♂ 11, ♀ 9. „ 17, v to 9, vi, 98. (*F. D. M.*)

♀ 1. Médéa, Hill north of railway station, 10, viii, 93. (*A. E. E.*)

♀ 1. Médéa, between Médéa and Lodi, on *Centaurea calcitrapa*, 14, vii, 93. (*A. E. E.*)
♀ 2. „ on *Daucus setifolius*, 30, vii and 2, viii, 93. (*A. E. E.*)
♂ 5, ♀ 1. Hippône, on *Ammi visnaga*, 10 and 12, viii, 96. (*A. E. E.*)
♂ 1. Le Tarf, on *Centaurea napifolia*, 17, vi, 96. (*A. E. E.*)
♀ 2. Bône, one on *Cynanchum acutum*, 30, vii and 23, viii, 97. (*A. E. E.*)

Dasypoda discincta, Rossi.

♂ 2, ♀ 1. Médéa, N. and N.E. of the town, alt. about 3,000 ft. on *Scolymus hispanicus*, 29, vi and 1, vii, 93. (*A. E. E.*)
♂ 1. „ N. slope of Koudia Sma, on *Scolymus hispanicus*, 8, vii, 93. (*A. E. E.*)
♀ 1. „ Ravines near Md. Ben Omar, alt. 2,730–3,130, on *Scolymus hispanicus*, 11, vii, 93. (*A. E. E.*)

Dasypoda plumipes, Pz. 3.

♂ 1. Biskra, near the grounds of Château Landon, 24, v, 93. (*A. E. E.*)
♀ 1. Bône, hillside in the plaine des Karézas, 6, xi, 93. (*A. E. E.*)

Cilissa maura, Per.

♀ 1. Biskra, right hand of the railway before the French Cemetery, visiting *Moricandia arvensis*, 25, iii, 95. (*A. E. E.*)

Nomioides pulchellus, Schenck.

♂ 1. Médéa, on *Dianthus*, 27, vi, 93. (*A. E. E.*)
♂ 1. Biskra, 9, vi, 98. (*F. D. M.*)

Nomioides variegatus, Oliv.

♂. Biskra, numerous examples visiting *Tamarix*, *Ammi visnaga*, and a tree with blue flowers in the Jardin by Fort St. Germain, 28, iii and 26, v, 93. (*A. E. E.*)
♂ 5, ♀ 3. Biskra, 13 to 28, v, 98. (*F. D. M.*)
♀ 1. Le Tarf, on *Fœniculum vulgare*, 26, vii, 96. (*A. E. E.*)

♂ 5, ♀ 4. Bône, on *Tamarix*, 29, vii to 20, viii, 97. (*A. E. E.*)
♀. „ 17, iii, 96. (*A. E. E.*)
♀ 3. „ i, v, 96. (*A. E. E.*)
♀ 1. „ on *Salsola kali*, 20, viii, 97. (*A. E. E.*)

Nomioides squamiger, n. sp.

Caput et thorax viridia pallido pilosa etiamque pubescentia albida (quæ tamen facillime deteri potest) vestita. Caput rotundatum scutellum et postscutellum flava, abdomen maris nigrum segmentorum apicibus flavis, feminæ flavum segmentis primo et secundo et nonnunquam sequentibus fascia nigra discali ornatis.

This species is very closely allied to *fallax*, Hdl., and may prove to be only a variety of it. It however differs in the following characters which appear to me to be more than varietal.

In both sexes the head and thorax are clothed with deciduous white scale-like pubescence, as well as with short erect pale hairs, this deciduous pubescence is more marked in the ♀ and the longer hairs more so in the ♂. The green colour of the surface is of a less bluish tint and in the ♂ the surface is duller. The abdomen in the ♂ has the apices of the 1st 2nd and 3rd segments broadly, of the 4th and 5th narrowly, and the entire 6th and 7th testaceous; in the ♀ the whole abdomen is very pale testaceous, the 1st 2nd and 3rd segments bearing a narrow slightly curved black line across the disc but not reaching either lateral margin, in some specimens the line on the 3rd segment is interrupted in the centre; the width of these lines varies considerably, and also their length, in some the line on the 3rd segment is absent, and in some there is a line on the 4th, and rarely one on the 5th.

Long $3\frac{1}{2}$–4 mm.

♂ 1, ♀ 3. Biskra, on *Ammi visnaga*, 18 to 24, v, 93. (*A. E. E.*)
♂ 6, ♀ 4. „ on a tree with blue flowers in the Jardin by Fort St. Germain, 26, v, 93. (*A. E. E.*)
♀ 2. „ on *Tamarix brachystylis*, 4, iv, 95 and iv, 97. (*A. E. E.*)
♀ 2. „ on *Zizyphus lotus*, 14 and 15, v, 97. (*A. E. E.*)
♂ 2, ♀ 2. „ 28, v and 9, vi, 98. (*F. D. M.*)
♂ 1, ♀ 1. Col de Sfa, on inconspicuous wiry *Umbelliferæ*, 27, v, 93. (*A. E. E.*)

♂. Between Tizi Ouzou and Azazga, on *Zizyphus lotus*, 12, vi, 93. (*A. E. E.*)
♂ 2. Médéa, on *Eryngium triquetrum* and *Mentha rotundifolia*, 10 and 19, vii, 93. (*A. E. E.*)

Nomioides deceptor, n. sp.

Præcedenti colore et pubescentia simillima, sed ab ea differt facie utroque sexu longiore, a *pulchello*, *variegatoque* thoracis pilis squamiformibus facile distinguenda.

Another species of very similar coloration and vestiture to the last; in the two males however which I possess one has a short black band on the basal segment of the abdomen only and the other has one on the 2nd segment also, in both the apical segments are more or less piceous, in the two females both show a short black band on the basal segment only, both sexes may be known from either *fallax* or *squamiger* by the longer face. This is distinctly longer than wide in the ♂, and oval not round in the ♀, the face of the ♀ much resembling that of *pulchellus* although a trifle wider, the ♂ has the face much less constricted than in *pulchellus* and the farinose scale-like pubescence distinguishes both the sexes from that species as well as from *variegatus* or *fallax*.

Long. $3\frac{1}{2}$–4 mm.

♂ 2, ♀ 2. Biskra, on *Ammi visnaga*, 18 and 24, v, 93. (*A. E. E.*)
♀ 1. ,, on *Deverra chlorantha*, 13, v, 97. (*A. E. E.*)

Nomioides excellens, n. sp.

Precedentibus multo major scutello viridi æneo, flavo bimaculato, abdomine utroque sexu flavo segmentorum apicibus nigro fasciatis.

A species of almost twice the bulk of any of the preceding. It has a round wide head in both sexes as in the ♀ of *deceptor* and is clothed with white deciduous pubescence as in that species and *squamiger* but differs from both of them in its much larger size, and in the colour of the scutellum; this only bears two testaceous spots as in the ♀ of *variegatus*, and the mesonotum of the ♀, just in front of the scutellum, is testaceous. This also is a character of *variegatus* but the broader face will distinguish it at once from that species in the ♀ and the pale abdomen with regular dark fasciæ in the ♂. These fasciæ in both sexes are wide and cover the apices of the segments, whereas in both *squamiger* and *deceptor* the fasciæ in the

♀ run across the disc and in the ♂ of these species it is the apical portion of the segments which is pale.

Long. $5\frac{1}{2}$–$5\frac{3}{4}$ mm.

1 ♂. Biskra, on a tree with blue flowers in the Jardin by Fort St. Germain, 26, v, 93. (*A. E. E.*)
♀ 2. ,, on *Ammi visnaga*, 18, v, 93 and 17, v, 97. (*A. E. E.*)
♀ 1. ,, on *Tamarix*, 29, iv, 97. (*A. E. E.*)

Panurgus platymerus, Per.

♂ 3, ♀ 1. Le Tarf, abundant on *Scolymus grandiflorus*; many spend the night among the florets curled up on their sides, 17, vi, 96. (*A. E. E.*)
♂ 3. Philippeville, 20, vi, 98. (*F. D. M.*)

Panurgus siculus, Mor.

♂ 2. Pointe Pescade, near Algiers, asleep in flowers of *Asteriscus maritimus*, lying over a little in the angle contained by the florets of the ray and disc, 27, iv, 93. (*A. E. E.*)
♂ 2. Constantine, on *Scolymus hispanicus*, 14, iv, 94. (*A. E. E.*)
♂ 2. ,, on *Sonchus tenerrimus*, 8 and 14, v, 95. (*A. E. E.*)
♀ 1. ,, on *Crepis taraxacifolia*, 23, v, 95. (*A. E. E.*)
♂ 3. Bône, on *Crepis taraxacifolia*, 20, iv and 4, v, 96. (*A. E. E.*)
♂♀. Sidi Ferruch, 8, v, 93. (*A. E. E.*)
♂. Tizi Ouzou, on *Compositæ*, 15, vi, 93. (*A. E. E.*)
♂ 18, ♀ 2. Alger, 28, iii, 98. (*F. D. M.*)
♂ 1, ♀ 2. Philippeville, 20, vi, 98. (*F. D. M.*)

Panurgus vachali, Per.

♂ 2, ♀ 2. Biskra, Garden of Château Landon, on *Leontodon* (*Kalbfusia*) *mulleri*, Schultz.—Bip., 15, iv, 94. (*A. E. E.*)
♂ 8, ♀ 7. ,, on *Picridium vulgare* and other yellow composites, 7 to 13, iv, 97. (*A. E. E.*)
♂ 1, ♀ 4. ,, 6 to 9, v, 98. (*F. D. M.*)

Panurgus calceatus, Per. = *algericus*, Friese.

♂ 1. Pointe Pescade, near Algiers, on *Asteriscus maritimus*, 10, v, 93. (*A. E. E.*)
♀ 1. Bône, on *Crepis taraxifolia*, 20, iv, 96. (*A. E. E.*)
♂ ♀. Aine Draham, 21, vii, 96. (*A. E. E.*)
♂ ♀. Le Tarf, 24, vi, 96. (*A. E. E.*)

Camptopœum handlirschi, Friese.

♂ 1, ♀ 2. Biskra, 20, v, 94. (*A. E. E.*)
♂ 4, ♀ 3. „ near Jardin Landon, on *Frankenia*, 15, v, 97. (*A. E. E.*)
♂ 7, ♀ 4. „ 5 to 23, v, 98. (*F. D. M.*)

Rophites algirus, Per.

♂ 3. Algiers, 29 and 30, iv, 98. (*F. D. M.*)

Panurginus variegatus, Mor.

♀ 1. Biskra, corn-fields along the Route des Ziban, on *Ammi visnaga*, Lam., 18, v, 93. (*A. E. E.*)
♀ 1. Hippône, on *Ammi visnaga*, 15, iii, 96. (*A. E. E.*)
♂ 1, ♀ 11. Biskra, 14 to 16, v, 98. (*F. D. M.*)

Panurginus albopilosus, Luc.

♂ 1, ♀ 2. Biskra, on *Diplotaxis pendula*, 14, iv, 94 and 26, ii to 13, iii, 97. (*A. E. E.*)
♂ 3, ♀ 3. Constantine, on *Diplotaxis muralis*, 21, v and 1, vi, 95. (*A. E. E.*)
♂ 6. El Guerrah, 3, v, 98. (*F. D. M.*)

Dufourea eatoni, n. sp.

Nigra, punctata, segmentorum abdominalium apicibus valde impressis pallide piceis et impunctatis. Maris antennarum articulis 2 and 3 brevissimis simul sumptis quarto sub-æqualibus, feminæ articulis flagelli transversis, subtus pallide testaceis—area propodealis impressa linea nitida circumdata.

♂. Black, shining, the deeply impressed apices of the abdominal segments pale piceous, head clothed with very pale ochreous hairs, those of the face white, vertex shining, remotely and rather unevenly punctured, antennæ with 2nd and 3rd joints very short and transverse, the two taken together about as long as the 4th the rest longer than wide each more or less curved,

especially the 8th 9th and 10th, thorax clothed with very pale ochreous hairs above, with white hairs beneath; mesonotum including the scutellum shining, remotely punctured, wings hyaline, nervures piceous, 2nd recurrent received in the 2nd submarginal cell, propodeal area depressed dull and finely rugose, bounded posteriorly by a shining curved somewhat raised line, abdomen strongly and remotely punctured and clothed with scattered pale hairs, the segments much raised across the disc, apical impressions very deep, pale and impunctate and crossed by a fringe of fine hairs which grow on the apex of the raised portion of the segments, legs with pale calcaria and clothed with white hairs.

♀ differs from the ♂ in the ordinary sexual characters, also in being more finely punctured. The antennæ are testaceous beneath and at the apex, and the joints of the flagellum are very short and transverse, vertex of the head and mesonotum rather closely but irregularly punctured, in this respect very different from *vulgaris*, propodeum like that of the ♂, puncturation of the abdomen less strong than in the ♂ but well marked, that of the basal segment stronger and more remote than of the others, impressions very wide and pale piceous, legs more or less piceous varying very much in depth of colour.

Long. ♂ 7, ♀ 6 mm.

2 ♂, 13 ♀. Biskra, on *Picridium vulgare*, 5 to 13, iv, 97. (*A., E. E.*)
♀. „ 12, v, 98. (*F. D. M.*)

Dufourea similis, Friese.?

♀ 1. Biskra, 6, v, 98. (*F. D. M.*)

This specimen, which bears a label in Herr Friese's handwriting *similis* (?) is very like the above, but differs in the shallower abdominal impressions and the more polished mesonotum which is scarcely punctured.

Rophites algirus, Per.

♂ 3. Algiers, 29 and 30, iv, 98. (*F. D. M.*)

Nomada nobilis, H. S.

♀ 1. Algiers, 25, iv, 98. (*F. D. M.*)

Nomada sexfasciata, Pz.

♀. Algiers, 1 to 5, iv, 98. (*F. D. M.*)

NOMADA SUCCINCTA, Pz.

♂ 1. Biskra, 3, v, 94. (*A. E. E.*)
♀ 3. „ hovering over the ground, 10 to 27, ii, 97. (*A. E. E.*)
♀ 1. Bône, 6, iv, 96. (*A. E. E.*)
♀ 1. Hippône, 8, iv, 96. (*A. E. E.*)

In both these females from Bône and Hippône the clypeus is entirely black.

NOMADA FULVICORNIS, Lep.

♂ 1. Bône, 28, iv, 96. (*A. E. E.*)
♂ 1. Algiers, 25, iv, 98. (*F. D. M.*)

NOMADA, sp.?

♂ 3. Biskra, ii and iii, 95 and 97. (*A. E. E.*)

Too discoloured to describe satisfactorily.

NOMADA CIRTANA, Per.

♂ 1, ♀ 2. Biskra, left of the Route de Tougourt, a little beyond Jardin Landon, among *Peridera fuscata*, Webb, 21, ii, 95. (*A. E. E.*)
♂ 2, ♀ 2. Bône, near the sea-shore among miscellaneous herbage, *Senecio leucanthemifolius*, etc., 15, ii, 96. (*A. E. E.*)
♂ 2. Hippône, beside the railway to Aine Mokhra, 10, iii, 96. (*A. E. E.*)
♀ 1. „ 8, iv, 96. (*A. E. E.*)

NOMADA TRIPUNCTATA, Mor.

♀ 1. Algiers, 9, iv, 98. (*F. D. M.*)

NOMADA TRIPUNCTATA, Mor., var.?

♂ 1. Bône, 5, vi, 96. (*A. E. E.*)

This is probably a distinct species but from a single ♂ I do not like to treat it as such. The tubercles and tegulæ and scutellar spots are ferrugineous not flavous and the hairs of the ventral segments are much shorter, the wings are more clouded and the 3rd submarginal cell wider. At the same time the general form of the insect is so similar to that of *tripunctata* that I think it safer not to describe it as new

Nomada andalusica, Schm.

♀ 1. Bône, 8, iv, 03. (*A. E. E.*)

Nomada agrestis, Fab.

♀ 1. Near Algiers, 6, iv, 93. (*A. E. E.*)
♂ 3, ♀ 3. Hippône, beside the railway to Aine Mokhra, 8 to 10, iii, 96. (*A. E. E.*)
♂ 1, ♀ 3. Algiers, 18 to 27, iii, 98. (*F. D. M.*)

Nomada pectoralis, Mor.

♀ 1. Between Médéa and Lodi, on *Centaurea calcitrapa*, 12, vii, 93. (*A. E. E.*)

Nomada scutellata, n. sp.

Læte ferruginea capite thoraceque nigro ornatis hoc longitudinaliter trivittato; capite subrostrato antennarum articulo tertio flagelli, secundo sesquilongiore abdomen ferrugineum, valvula anali apice leviter exciso tibiis posticis apice sexspinosis. Alis valde valde infumatis.

♂ Head rufo-testaceous the vertex posteriorly extending in an angular form to the anterior ocellus and the region of the insertion of the antennæ black; antennæ dark on the 4th and following joints; thorax rufo-testaceous, mesonotum with a wide central stripe and a narrow one on each side, metanotum except the post-scutellum, propodeum, the whole of the thorax beneath except a large spot on the mesopleuræ with a small spot above it, black. Wings of a dark smoky colour, hind coxæ above, and a stain on the underside of the hind femora, black.

Head slightly rostrate, closely and rugosely punctured, sparingly clothed with short reddish hairs, cheeks between the eyes and mandibles developed, labrum nearly twice as wide as long, its sides rounded and its apex truncate, there is a very fine raised line visible down its centre, this is elevated at the apex into a very small compressed tubercle. Antennæ with the 2nd 4th and following joints of the flagellum viewed from beneath subequal, each about three-quarters the length of the 3rd and slightly longer than wide. Mesonotum very closely and deeply punctured, nearly glabrous, the punctures often confluent, scutellum raised into two rather angular, divergent tubercles, very strongly punctured, propodeum dull, clothed with short black hairs, its area rugose at the base, its sides beyond the area finely rugulose and punctured, hind tibiæ with 6 ferruginous spines. Abdomen rather dull, very finely and closely

punctured the basal segment more shining and less closely so, with 4 small darker spots in a line across it near the base, all the segments have the extreme apex shining, impunctate and slightly darkened, 7th segment slightly notched at the apex, beneath finely punctured, the apices of the segments widely impunctate and shining.

Long. 14 mm.

♂ 1. Biskra, corn-lands along the Route des Ziban, on *Ammi visnaga*, 25, v, 93. (*A. E. E.*)

NOMADA PLANISCUTA, n. sp.

Rufo-testacea, capite thoraceque nigris, rufo ornatis, scutello planiusculo, mesopleuris nitidis, valde punctatis, alarum, cellula cubitali tertia angusta, superne constricta, tibiis posticis, spinis duabus curvatis valde approximatis, more *succinctæ*, munitis.

♀. Rufo-testaceous, a triangular spot on the vertex of the head its apex reaching to the insertion of the antennæ, the thorax and propodeum, with the exception of a spot on each side of the pronotum, the tubercles, tegulæ, scutellum, and post-scutellum as well as a spot on each of the mesopleuræ bordering the prothorax, black. The coxæ of the front and hind pairs of legs are also almost entirely black; wings smoky-brown, apices of the 2nd and 3rd abdominal segments more or less infuscate. Head short, strongly punctured, cheeks not developed, labrum sparingly clothed with pale hairs, punctured, bearing a very small laterally compressed tubercle near its apex, antennæ with the 2nd and 3rd joints subequal, 4th slightly shorter, the rest nearly quadrate, vertex and cheeks behind the eyes clothed with short black hairs, mesonotum closely and strongly punctured, with signs of having had a clothing of short black hairs (both my specimens judging from the condition of the wings are possibly more or less rubbed), scutellum not raised, shining, rather more largely and less closely punctured than the rest of the mesonotum, its centre impressed posteriorly, mesopleuræ shining very largely and distinctly punctured, wings with the 3rd submarginal narrow, much contracted above (in one specimen this cell in the right hand wing is divided in two by a transverse nervure situated towards its apex), propodeum punctured at the sides, its area very finely rugulose, its extreme base slightly rougher, hind tibiæ with two curved short spines, close together, as in *succincta*, *mephisto*, *fucata*, *manni*, etc.; abdomen closely punctured, with only the extreme posterior edges of the segments shining, apex of the 5th segment clothed with whitish hairs.

Long. 11 mm.

♀ 1. Médéa, hill north of railway-station, on *Eryngium triquetrum*, 29, vi, 93. (*A. E. E.*)
♀ 1. „ North of the town; alt. about 3,000 ft., 1, vii, 93. (*A. E. E.*)

Nomada brevis, n. sp.

Brevis, abdomine subgloboso thoraci longitudine æquali. Capite thoraceque nigris, rufo hirsutis, labro, antennis, tegulis, tuberculis, scutelloque rufis, abdomine ferrugine, tibiis posticis apice pallide et obtuse 3-spinosis.

♀. A short compact species whose abdomen is about as long as the thorax and quite of a short oval form; head and thorax black, mandibles except their apices, labrum, antennæ, tubercles, tegulæ, and scutellum ferruginous, abdomen entirely and legs ferrugineous except the coxæ and trochanters of the 2nd and 3rd pair which are black. Labrum very closely and rugosely punctured, transversely concave towards the apex, no visible tooth or tubercle, face clothed with brownish-red hairs, antennæ with all the joints of the flagellum subequal with the exception of the diminutive 1st. Vertex and thorax dull, very closely and rugosely punctured and clothed with brownish-red hairs, scutellum scarcely raised, a little less dull than the rest of the mesonotum, wings smoky, nervures dark brown, propodeum dull, clothed like the thorax, largely and closely punctured, its area very finely rugulose. Abdomen shining, basal segment impunctate, the others finely and rather closely punctured on the basal half, their apices widely impunctate; 5th clothed at the apex with whitish hairs, posterior tibiæ armed exteriorly at the apex with 3 short pale obtuse spines.

Long. 6 mm.

♀ 1. Biskra, in the garden of Château Landon, 15, iv, 94. (*A. E. E.*)

Nomada, sp.

This ♀ is allied to *rhenana*, it has the labrum red with a small central tubercle, the 2nd and 3rd joints of the flagellum subequal and the apex of the hind tibiæ with 5 rather unequal sharp pale spines. As I have only seen this single female which has no very pronounced characteristics I refrain from describing it.

♀ 1. Biskra, 27, ii, 97. (*A. E. E.*)

Nomada præstans, n. sp.

Capite thoraceque nigris ochraceo pilosis, abdomine læte testaceo, antennis longis, flagelli articulo secundo tertio sesquilongiore,

reliquis latitudine longioribus, tibiis posticis feminæ, apice tri-vel quatuorspinosis, spinis pallidis.

♂ ♀. Head and thorax black, the mouth parts including the apex of the clypeus and the sides of the face along the orbits of the eyes and the antennæ testaceous. The scape of the antennæ above is black in the ♂ and has a black stain near the apex in the ♀, and in one ♂ the first 5 joints of the flagellum are black above. The tubercles and tegulæ are ferrugineous in both sexes and there is sometimes a small spot of that colour on the scutellum of the ♂, wings slightly infuscate, nervures testaceous, the abdomen with the exception of the extreme base and a small black spot at the base of the 2nd segment laterally is entirely clear testaceous, legs testaceous, the coxæ in both sexes and the intermediate and hind femora beneath in the ♂ black. ♂. Head and thorax dull very closely punctured and rather densely clothed with ochraceous hairs, labrum simple, clothed with long hairs, its anterior margin slightly angulated in the centre, mandibles acute, antennæ with the 2nd joint of the flagellum once and a half as long as the 3rd which is nearly twice as long as wide, the rest are distinctly longer than wide ; propodeum densely punctured and hairy at the sides, its area finely clathrate. Abdomen finely and closely punctured, with a fine but inconspicuous ochreous pubescence, apical dorsal valve narrowly notched at the apex ; posterior tibiæ with 3 or 4 pale apical spines intermixed with pale hairs. ♀. Very like the ♂ but head and thorax much less hairy, labrum simple, nearly glabrous, antennæ with the 2nd and 3rd joints of the flagellum subequal, the rest slightly longer than wide, abdomen more shining and less closely punctured, apices of the segments widely smooth and shining, impunctate, apical fimbria of 5th segment whitish; apex of the posterior tibiæ with two very short pale spines.

Long. 8–9 mm.

Apparently a very distinct species of which I can find no description, its long antennæ and the clear pale testaceous colour of the abdomen and legs give it a rather unusual appearance.

♀ 1. Bône, Route de l'Edough at the beginning of the ascent, 7, iii, 96. (*A. E. E.*)
♂ 1. „ by the railway near Hippône, 16, ii, 96. (*A. E. E.*)
♂ 1. „ by the Bône-Guelma railway, opposite Ferme Laccombe, 23, iv, 96. (*A. E. E.*)

Nomada multispinosa, n. sp.

Polyacanthæ Per. affinis, sed mesonoto crebre punctato, et tibiis

posticis spinulis nigris magis quam in illa specie armatis facile distinguenda.

♀. Apparently closely allied to *polyacantha* Per. but differing from it in the closely punctured mesonotum and the greater number of spines on the apical portion of the tibiæ. Head and thorax black, face below the antennæ including the labrum and mandibles except at the apex, the orbits of the eyes, the antennæ, with the exception of the intermediate joints which are fuscous, the pronotum, tegulæ, tubercles, scutellum, post-scutellum and almost the entire mesopleuræ rufotestaceous; legs and abdomen entirely of that colour, wings brown with a very conspicuous clear spot beyond the 3rd submarginal cell. Face clothed with short scattered pale hairs, labrum with a small tubercle near the middle, clypeus shining, finely and rather remotely punctured, face below the antennæ rather remotely, above them closely punctured; antennæ with the 2nd and 3rd joints of the flagellum subequal, the 3rd and following joints subquadrate; mesonotum shining, closely and deeply punctured, the intervals between the punctures much narrower than the punctures themselves, scutellum slightly raised into two obtuse tubercles largely and less closely punctured than the thorax, propodeum finely rugulose, its area more or less clathrate at the base, each side with a patch of silvery white hairs; posterior tibiæ, with their external apex densely clothed with black spines numbering probably 20 or more but so closely packed that I find it impossible to count them; abdomen very shining, short oval, 1st segment impunctate or nearly so, the rest finely and regularly punctured on the basal half, impunctate on the apical, 5th fringed with whitish hairs at the apex, 2nd and following segments more or less clothed with silvery hairs at the sides.

Long. 8 mm.

♀ 1. Le Tarf, near the village, 17, vi, 96. (*A. E. E.*)
♀ 2. La Calle, 4 and 9, vii, 96. (*A. E. E.*)

Nomada panurginoides, n. sp.

N. panurginæ, Mor., simillima, mesonoto crasse punctato antennarum flagelli articulo secundo maris tertio subæquali, feminæ paullo breviore, facile distinguenda.

♂ ♀. Exceedingly like *panurgina*, Mor., head and thorax black, mouth parts, labrum, clypeus in the ♀, antennæ, pronotum, tegulæ scutellum and post-scutellum, mesopleuræ and sterna ferruginous-red, in the ♀, 2 spots on the scutellum and 1 on the post-scutellum and a small spot on the mesopleuræ only in the ♂; abdomen ferruginous-red, its base and a lateral spot at the base

of the 2nd and 3rd segments a band at the apex of the 3rd and at the base of the 4th black. Legs ferruginous, the hind femora and the tibiæ on the side towards the body black in both sexes. Head and thorax shining, face clothed rather densely in the ♂, and very sparingly in the ♀ with silvery hairs. Labrum trituberculate, the tubercles arranged in a triangle. Antennæ with the 2nd joint of the flagellum subequal to the 3rd in the ♂, rather longer than the 3rd in the ♀, mesonotum largely and rather closely punctured, the punctures sometimes less than their own diameter apart at others nearly twice their diameter, wings smoky-brown, with a paler region near the apex, propodeum with a patch of silvery hairs on each side. Abdomen finely punctured on the 2nd segment, exceedingly finely and more closely so on the following, apex of the dorsal valve in the ♂ notched.

Long 6½–7 mm.

Easily distinguished from *panurgina*, Mor., of which I possess a specimen from Professor Perez and from *jullianii*, Schm., by the much coarser puncturation of the mesonotum, the punctures being quite twice as large, and also by the greater proportional length of the 3rd joint of the flagellum.

♂ ♀. Biskra and Constantine, numerous specimens, iv and v, 95 and 97. (*A. E. E.*)

♀. Constantine and Algiers, many, vi, 98. (*F. D. M.*)

NOMADA CARNIFEX, Mocs.

♀ 1. Bône, 16, iii, 96. (*A. E. E.*)

♀ 1. Algiers, 18, iii and 7, iv, 98. (*F. D. M.*)

I have followed Gribodo in referring these specimens to Mocsary's species, the three prominent teeth on the labrum afford a very characteristic feature.

NOMADA, sp.?

♀ 1. Bône, near the Orphelinat, 2, iii, 96. (*A. E. E.*)

Like a diminutive *carnifex* but without the peculiar armature of the labrum, and the posterior tibiæ with 5 pale spines of which the last is longest.

NOMADA FERRUGINATA, L?

♀ 1. Algiers, 19, iv. 98. (*F. D. M.*)

NOMADA CONNECTENS, Per.

♀ 3. Constantine, 18 to 20, vi, 98. (*F. D. M.*)

NOMADA DISCREPANS, Schm.

♂ ♀. Numerous. Bône, iii, iv; Hippône, iii; Constantine, v, vi; Algiers, iii, iv; Biskra, ii, iii. (*A. E. E.*)

♂. Occurring at Biskra, on *Peridera fuscata*; at Constantine, on *Hypochæris glabra*. (*A. E. E.*)

NOMADA FLAVOGUTTATA, K.

♂ ♀. Algiers, 16, iii and 7, iv, 98. (*F. D. M.*)

NOMADA DISTINGUENDA, Mor.

♂ 1. Aine Draham, 21, vii, 96. (*A. E. E.*)
♀ 1. Bône, 22, iii, 96. (*A. E. E.*)

NOMADA HIPPONENSIS, n. sp.

N. distinguenda, etc., affinis. Mas, antennarum flagelli articulis 3^tio^, 4^to^, 5^to^, 6^o^ subtus tuberculatis, femina articulo secundo sequentibus æquali, latitudine longioribus.

♂ ♀. A small species, of the same size and general aspect of *distinguenda*, etc. Brown, mouth parts including the labrum, clypeus and the lower part of the sides of the face, the antennæ, the pronotum above, more or less, the tubercles, tegulæ, two spots on the scutellum, united in the ♀, the post-scutellum, the abdomen except at the extreme base and legs, entirely in the ♀, partially only in the ♂, rufo-testaceous.

♂. Face clothed with ochreous hairs, antennæ with the 2nd and 3rd joints of the flagellum subequal, its basal joints to the 6th more or less infuscate posteriorly, joints 3, 4, 5 of the flagellum distinctly and 6 indistinctly tuberculate beneath, all the joints of the flagellum, except the small basal one, as long as wide, those nearer the base slightly longer. Mesonotum closely and strongly punctured sparingly clothed with ochreous hairs, scutellar tubercles slightly raised, propodeum finely rugose, bearing a patch of silvery hairs on each side, legs with the apices of the joints of all the legs and the front legs almost entirely, rufo-testaceous, posterior tibiæ in the ♀ with 2 short and 1 very long pale spine at the apex. Abdomen shining, vaguely and very finely punctured on the basal halves of the segments, in the ♂ the abdomen is brown with paler bands or spots, on the 2nd and 3rd segments, these are more or less indicated according to the darkness of the specimen.

Long. 5–5½ mm.

The peculiar antennæ of the ♂ recall that sex of *cyphognatha*, Perez, but the tubercles are fewer and

diminish in size on the more apical joints, whereas in *cyphognatha*, Professor Perez says, "la dernière la plus forte." The labrum also is simple.

♂ 3, ♀ 1. Hippône, on *Ammi visnaga*, 15, viii, 96. (*A. E. E.*)

NOMADA FURVA, K.

♂ 1. Médéa, 26, vi, 93. (*A. E. E.*)
♂ 2. Algiers, 4 and 7, iv, 98. (*F. D. M.*)
♀ 1. Biskra, 13, v, 98. (*F. D. M.*)

NOMADA, sp.

♂ 1. Bône, 20, iv, 96. (*A. E. E.*)

A species generally resembling the species of the *distinguenda* group but the antennæ have the joints of the flagellum wider than long and the 2nd and 3rd joints subequal and of the same length as the remainder, the labrum is pale without noticeable tubercles.

NOMADA, sp.

♀ 1. Bône, Valley of the Oued Deb, 11, v, 96. (*A. E. E.*)

This ♀ has the 2nd and 3rd joints of the antennæ subequal and the hind tibiæ armed at the apex with 5 or 6 exceedingly short brown spines; its position is to me doubtful and as it is a single ♀ I think it better to leave it undescribed.

PASITES MACULATUS, Jur.

♂ 1. Hippône, 15, viii, 96. (*A. E. E.*)
♂ 1, ♀ 3. Biskra, 24, iv to 7, vi, 97. (*A. E. E.*).
♂ 4, ♀ 7. Biskra, 10, v to 9, vi, 98. (*F. D. M.*)

The females are all of the variety with the thorax almost entirely red.

AMMOBATES ORANIENSIS, Lep.; = *melectoides*, Smith.

♀ 2. Algiers, 4 and 5, v, 93. (*A. E. E.*)
♂ 1. Bône, beyond the Orphelinat, parasitic on *Odynerus consobrinus*, Duf., 22, iii, 96. (*A. E. E.*)
♀ 1. Bône, 23, v, 96. (*A. E. E.*)
♂ 6, ♀ 1. Constantine, 18, iii to 14, vi, 1898. (*F. D. M.*)

AMMOBATES CARINATUS, Mor.

♀ 1. Médéa, N. of the town, alt. about 3,000 feet, on *Scabiosa maritima*, 1, vii, 93. (*A. E. E.*)

♂ 3. Algiers, on the ramparts, parasitic on *Eucera nigrifacies*, frequenting its burrows in the soil, 4, iv, 93. (*A. E. E.*)
♂ 2. Sidi Ferruch, 8, v, 93. (*A. E. E.*)

AMMOBATES HANDLIRSCHII, Fries.

♀ 1. Biskra, on *Amberboa lippii*, 8, iv, 97. (*A. E. E.*)

AMMOBATES RUFIPES, n. sp.

Caput thoraxque nigra, abdomine pedibus que maxime parte rufis. Antennarum flagelli articulo secundo tertio longiore, mas vertice pone ocellos triangulariter opaco et crebre punctato femina segmento sexto abdominis impressione ovali transversa nitida, et postice punctata instructo.

♂ ♀. Black, labrum, base of the mandibles, antennæ towards the base and tubercles of prothorax in the ♀, abdomen and legs except the trochanters and coxæ in both sexes ferruginous; femora in the ♂ black except towards the apices of the hind pair. Head and thorax closely and rugosely punctured, face slightly shining, clothed with pale hairs round the insertion of the antennæ, vertex in the ♂ closely punctured and dull. This dull area extends angularly to the anterior ocellus and covers the space between the ocelli, at the sides of this triangle the surface of the head is shining and very largely punctured, in the ♀ this character is scarcely observable, in both sexes there is a slight carina on the centre of the vertex extending in the direction of the central ocellus, antennæ with the 2nd joint of the flagellum rather longer than the 3rd, the rest wider than long in the ♂, subquadrate in the ♀, pronotum clothed with a tight-fitting ochreous pubescence, wings smoky-brown. Scutellum slightly raised and shallowly channelled, post-scutellum scarcely raised, propodeum clothed with silvery pubescence at the base and sides, excavated and shining posteriorly, its area slightly raised, with a fine central channel. Abdomen very finely and closely punctured, 7th segment in the ♂ strongly so, 6th segment in the ♀ posteriorly slightly emarginate, bearing a transversely oval shining impression towards the apex, the apical half of which is largely punctured, legs and especially the coxæ, more or less clothed with silvery pubescence.

Long. 11 mm.

♂ 2, ♀ 6. Le Tarf, visiting heads of *Cynara cardunculus*, 23 to 25, vii, 96. (*A. E. E.*)
♀ 1. Biskra, on *Ammi visnaga*, 26, v, 97. (*A.E.E.*)

Apparently allied to *robustus*, Friese, but that species may be easily distinguished by the form of the sixth segment of the abdomen which he describes as bearing a trapeziform dull space, he also speaks of the legs being black and the abdominal segments more or less banded at their apices with silvery hairs.

AMMOBATES BIASTOIDES, Friese.

♂ 1. Biskra, 23, v, 98. (*F. D. M.*)
♂ 2. Biskra, cornfields along the Route des Ziban, on *Ammi visnaga*, 23 to 28, v, 97. (*A. E. E.*)

AMMOBATES, sp. ?

♂ 1. La Calle, 9, vii, 96. (*A. E. E.*)

SCHMIEDEKNECHTIA ORANIENSIS, Friese.

♀ 1. Constantine, 15, vi. 98. (*F. D. M.*)

PHIARUS SCRIPTUS, Gerst.

♀ 1. Biskra, near railway, Kilom. 108, 17, v. 94, "asleep holding on by its mandibles to a twig of *Deverra scoparia*. When alarmed extending all its legs upwards with a warning buzz like *Bombus*, but *Bombus* only holds up some of its legs at a time." (*A. E. E.*)

There seems to have always existed a great deal of confusion about Smith's *Philoremus melectoides*. This is unquestionably identical with *Ammobates oraniensis*, Lep. Smith distinctly says it has two jointed maxillary palpi, which fact at once separates it from *Phiarus* which has six joints to those organs. Besides this I have an example from *Albania* named by Smith himself.

EPEOLUS FALLAX, Mor.

♂ 1. La Calle, sandhills west of the town, 19, vii, 96. (*A. E. E.*)

EPEOLUS AUREOVESTITUS, Dours.

♀ 1. Biskra, 10, vi, 98. (*F. D. M.*)

EPEOLUS, sp. ? (? *male of preceding*).

♂ 1. Biskra, 3, vi, 98. (*F. D. M.*)

EPEOLUS SUBRUFESCENS, n. sp.

Caput et thorax nigra, supra pilis adpressis ochraceis, subtus albis, vestita; abdomen laete brunneum, fasciis latis ochraceis ornatum, pedes antennæ-que testacei.

Head and thorax black, so densely clothed with closely-fitting scale like hairs that the surface can hardly be seen, the clothing of the upper surface of the thorax and the vertex of the head is ochreous, that of the face and under-side of the thorax and of the post-scutellum and the propodeum white, abdomen testaceous-brown, basal segment clothed with pale ochreous hairs except a central band of bright chocolate-brown hairs which does not reach the margin on either side, 2nd segment clothed at the base with bright chocolate hairs, at the apex with a wide band of ochreous hairs which is considerably and suddenly widened at the sides, 3rd 4th and 5th almost entirely covered with ochreous hairs, antennæ and legs testaceous, wings clouded at the apex, nervures testaceous. Labrum largely punctured, its anterior margin entire or slightly sinuate; two very small tubercles are situated at about a third of the length of the labrum from its apex. Antennæ with the 2nd joint of the flagellum longer than the third, the remainder subquadrate, scutellum with the lateral teeth long, its central lobe emarginate with a well-marked angular tooth on each side, the sculpture is everywhere hidden by the closeness of the pubescence.

Long. 7 mm.

A species closely allied to *aureovestitus*, Dours, but differing so widely in colour, and in the entire bands of the abdomen that I think there is no doubt of its being distinct.

♀ 1. Biskra, 24, iv, 97. "Eyes in life brownish-agate-grey with deep-seated dark fenestrations." (*A. E. E.*)

XYLOCOPA VIOLACEA, L.

♂ ♀. Algiers, 24, ii and 13, iv, 93. (*A. E. E.*)
♀. Médéa, 26, vi, 93. (*A. E. E.*)

Dr. Longstaff took it at flowers of *Prunus*, 11, iii, 05; at flowers of a shrubby yellow *Cineraria*, at Hammam Meskroutine; at Asphodel flowers at Hamman Rhirha, 21, iii, 05.

XYLOCOPA CYANESCENS, Brullé.

♂. Médéa, on *Eryngium triquetrum*, 29, vi, 93. (*A. E. E.*)
♂. Constantine, 9, x, 93. (*A. E. E.*)
♀. Tizi Ouzou, 15, vi, 93. (*A. E. E.*)
♀. Bône, 23, iv, 96. (*A. E. E.*)

CERATINA CUCURBITANA, Rossi.

♂ ♀. Common in various localities (*A. E. E.* and *F. D. M.*), generally on *Echium*, but visiting *Onopordon macracanthum* at Médéa in June; *Lythrum salicaria* and *Euphorbia paralias* at Bône in August; *Centaurea* at Aine Draham in July; and *Eryngium tricuspidatum* at Azazga in September. (*A. E. E.*)

CERATINA PARVULA, Sm.

♀ 11. Bône, on *Centaurea seridis* and *Rubus discolor*, 31, vii to 21, viii, 97. (*A. E. E.*)

CERATINA MOCSARYI, Friese.

♀ 1. Médéa N. and N.E. of town, alt. about 3,000 feet, on *Onopordon macracanthum*, 1, vii, 93. (*A. E. E.*)
♀ 1. „ near Maison Berronis, alt. 2,980 feet, on *Centaurea calcitrapa*, 12, vii, 93. (*A. E. E.*)
♀ 1. „ summit of hill, north of railway-station, on an *Allium*, 14, vii, 93. (*A. E. E.*)
♀ 1. Aine Draham, 21, vii, 96. (*A. E. E.*)

CERATINA NIGROÆNEA, Gerst.

♀ 1. Philippeville, 20, vi, 98. (*F. D. M.*)

CERATINA CALLOSA, F.

♀ 1. Médéa, on *Atractylis gummifera*, 12, viii, 93. (*A. E. E.*)
♂ 1. Azazga, 31, viii, 93. (*A. E. E.*)
♀ 1. Bône, 6, xi, 93. (*A. E. E.*)
♂ 1. Constantine, visiting *Thapsus garganica*, 16, v, 95. (*A. E. E.*)
♂ 1. „ visiting *Carduus pycnocephalus*, 20, v, 96. (*A. E. E.*)
♂ 1, ♀ 3. Biskra, on *Antirrhinum ramosissimum*, 23 and 29, iii, 97. (*A. E. E.*)
♀ 1. „ on *Amberboa lippii*, 8, iv, 97. (*A. E. E.*)
♀ 1. „ on *Atractylis serratuloides*, 13, v, 97. (*A. E. E.*)
♀ 1. Bône, on *Chrozophora tinctoria*, 3, viii, 97. (*A. E. E.*)
♂ 1, ♀ 3. Constantine, 13 to 7, v, 98. (*F. D. M.*)

Ceratina callosa, F, *forma minor*.

♂ 1. Biskra, 25, iv, 97. (*A. E. E.*)
♂ 1, ♀ 1. Bône, on *Centaurea seridis*, *in cop.*, 2, viii, 97. (*A. E. E.*)
♂ 1, ♀ 1. „ on *Chrozophora tinctoria*, 3 and 11, viii, 97. (*A. E. E.*)
♂ 2. „ on *Salsola kali*, 23, viii, 97. (*A. E. E.*)
♂ 3, ♀ 1. Médéa, 26, vi, 93. (*A. E. E.*)
♂ 3, ♀ 1. Bouira, 2, v, 98. (*F. D. M.*)
♂ 4, ♀ 2. Algiers, 19, iii to 30, iv, 98. (*F. D. M.*)
♂ 1. Philippeville, 21, vii, 98. (*F. D. M.*)

Ceratina dallatorreana, Friese.

♂ 1. Tizi Ouzou, on *Echium*, 14, vi, 93. (*A. E. E.*)
♀ 1. Bône, on *Salsola kali*, 23, viii, 97. (*A. E. E.*)
♀ 2. „ 30, iv, 96 and 31, vii, 97. (*A. E. E.*)
♀ 1. Azazga, 30, viii, 93. (*A. E. E.*)

Paradioxys moricei, Friese.

♂ 1, ♀ 2. Biskra, in railway-cutting, near Kilom. 199, entering burrows of *Osmia rubricrus* in sandy soil rather caked on the surface. ♂ and ♀ taken *in cop.*, 21, iv, 95. (*A. E. E.*)
♂ 3, ♀ 8. As above, 24 and 25, iv, 97. Eyes ♂ olive-grey, ♀ olive-brown, with the usual deep-seated fenestrations. (*A. E. E.*)
♂ 1. Biskra, at flowers of *Zizyphus lotus*, 29, iv, 95. (*A. E. E.*)
♂ 3, ♀ 3. „ in company with *Osmia rubricrus*, 6 to 12, v, 98. (*F. D. M.*)

Dioxys cincta, Jur.

♀ 1. Bône, 10, vi, 96. (*A. E. E.*)
♀ 1. Sidi Ferruch near Algiers, 8, v, 93. (*A. E. E.*)
♂ 7. Algiers, 5 to 11, iv, 98. (*F. D. M.*)

Dioxys rotundata, Per.

♀ 1. Biskra, visiting *Brassica napus*, 27, ii, 97. (*A. E. E.*)
♀ 1. Algiers, 30, iv, 98. (*F. D. M.*)

Cœlioxys, sp. ?

♀ 1. Constantine on M'cid near the Jewish Cemetery, visiting *Convolvulus lineatus*, 9, v, 95. (*A. E. E.*)

Cœlioxys afra, Lep.

♀ 1. Tizi Ouzou, in the public gardens, entering burrow, "Eyes dark brown," 14, vi, 90. (*A. E. E.*)

Cœlioxys coturnix, Per.?

Of this species only the ♀ is described by Perez. The ♂ may be known from that of *hæmorrhoa* by the following characters: the shorter and more scale-like hairs of the mesonotum are evenly distributed all over the surface and not collected into spots as in *hæmorrhoa*, also the cheeks behind the eyes are clothed with scale-like hairs, whereas in *hæmorrhoa* these hairs are of the ordinary type, the transverse impressions of the abdomen are deeper and the bands are made up of several rows of scales throughout their extent, the entire base of the 7th segment is clothed with white hairs and not only its centre—beneath the whole surface is clothed with scales.

♂ 2, ♀ 2. Biskra, 27, v to 7, vi, 1898. (*F. D. M.*)

In both the female specimens the abdomen is red at the base.

Cœlioxys hæmorrhoa, Först.

♂ 1. Médéa, on *Eryngium triquetrum*, 26, vi, 93. (*A. E. E.*)
♀ 1. „ „ „ 10, vii, 93. (*A. E. E.*)
♂ 1. Constantine „ „ 10, vi, 95. (*A. E. E.*)
♂ 1, ♀ 1. Médéa, on *Mentha rotundifolia*, 19, vii, 93. (*A. E. E.*)
♀ 1. Constantine, 1, x, 93. (*A. E. E.*)
♀ 1. Biskra, on *Ammi*, 19, vi, 97. (*A. E. E.*)
♂ 1. Bône, 12, viii, 97. (*A. E. E.*)
♂ 1. Constantine, 17, vi, 98. (*F. D. M.*)

Cœlioxys rufocaudata, Sm.

♀ 1. Le Tarf, 19, vi, 96.

"This bee sleeps head downwards, holding on to a grass-stem by its mandibles: the fore tarsi and intermediate tarsi deflexed or flexed backwards respectively in a continuous line with the tibiæ (which are folded up closely upon the femora and body), do not necessarily touch the stem, the intermediate tarsi lie obliquely across the basal joinings of the posterior femora and in a line

with the posterior tarsi, reaching to just before the base of the 1st joint in the hind tarsus. The hind tarsi from the tibiæ to the 2nd joint are connivent, and from the 3rd joint onwards parallel and contiguous with each other, are applied to the venter and reach to just beyond the apex of the 2nd ventral segment, the antennæ are sometimes porrect, and subparallel, but if the insect be slightly disturbed they become divergent. A specimen found asleep on a grass-stem on the 25th which was plucked and carried back to the house by hand, kept its place for thirty hours in an ill-lighted bedroom, when a strong daylight being admitted, it flew away." (*A. E. E.*)

Cœlioxys brevis, Ev.

♂ 1. Médéa, slopes of the Nador, alt. about 3,670 feet, on *Eryngium triquetrum*, 2, vii, 93. (*A. E. E.*)
♂ 2, ♀ 5. Biskra, 14, v to 12, vi, 98. (*F. D. M.*)
♂ 1, ♀ 2. „ 18 to 24, v, 97. (*A. E. E.*)
♀ 1. „

♂. *Biskra.* "Near the French cemetery, about 6 p.m., holding on with legs and mandibles to a twig; the tail curved upwards, and the wings so close down to the body as not to be easily distinguished, causing one to doubt if the insect were a bee or a beetle until examined with a lens. 22, v, 94. (*A. E. E.*)

Cœlioxys decipiens, Spin.

♂ 1, ♀ 1. Biskra, ♂, on *Atractylis serratuloides*, 11 and 19, v, 97. (*A. E. E.*)
♀ 1. „ 4, v, 98. (*F. D. M.*)

Chalicodoma sicula, Rossi.

♂ ♀. Numerous specimens from various localities visiting *Echium*, *Hedysarum carnosum*, *Lavendula stœchas*, *Linaria reticulata*, and *Antirrhinum ramosissimum*, 26, ii to 22, vi. (*A. E. E.*)

(Dr. Longstaff took it in February and March 1905, on *Retama retam*, near Biskra, and on Guyotville sandhills.)

Chalicodoma muraria, L.

♀ 5. Biskra and Constantine, visiting *Eriochilon fruticosum*, Desf., and *Ononis angustissima*, Lk., in March, *Alkanna tinctoria* in May. (*A. E. E.*)

CHALICODOMA LEFEBVREI, Lep.

♀ 1. Constantine, M'cid, on *Eryngium triquetrum*, 23, vi, 94. (*A. E. E.*)
♀ 1. Constantine, near the falls of the Roumel, 1, vi, 95. (*A. E. E.*)

CHALICODOMA GENEANA, Grib.

♀ 2. Algiers, 11 and 14, iv, 98. (*F. D. M.*)

CHALICODOMA NASIDENS, Friese.

♂ 1, ♀ 1. Biskra, 12, iv, 95 and 27, v. 93. (*A. E. E.*)
♂ 2, ♀ 1. „ visiting *Atractylis serratuloides*, 6 to 13, v, 97.
♀ 1. „ visiting *Echinops spinosus*, 8, v, 97. (*A. E. E.*)
♂ ♀ 1. „ visiting *Antirrhinum ramosissimum*, the ♂ of a variety with hairs of apical segments red, 29, iii and 10, v, 97. (*A. E. E.*)

(Dr. Longstaff took 4 males of this species at Biskra, at flowers of *Retama retam*, February and March 1905.)

MEGACHILE LAGOPODA, L.

♂ 2, ♀ 1. Aine Draham, 21, vii, 96. (*A. E. E.*)
♀ 1. Médéa, on *Centaurea*, 26, vi, 93. (*A. E. E.*)

MEGACHILE ERICETORUM, Lep.

♀ 1. Constantine, visiting *Marrubium vulgare*, 21, v, 95. (*A. E. E.*)

MEGACHILE SERICANS, Fonsc.

♀. Damiette, near Médéa, on *Microlonchus salmanticus*, 11, vii, 93. (*A. E. E.*)
♀. Médéa, on *Mentha rotundifolia*, 11, viii, 93. (*A. E. E.*)

MEGACHILE PICICORNIS, Friese.

♀. Tizi Ouzou, on the slope of Mount Beloua, on *Centaurea*, 14, vi, 93. (*A. E. E.*)

MEGACHILE MELANOTA, Per.

♂ ♀. Azazga, Forêt de Yakouren, 12 and 19, ix, 93. (*A. E. E.*)
♀. Sidi Ferruch, 8, v, 93. (*A. E. E.*)

MEGACHILE INSTERSTINCTA, Gerst.

♀ 1. Constantine, 19, vi, 98. (*F. D. M.*)

MEGACHILE APICALIS, Spin.

♂ 2. Médéa, 28, vi, 93. (*A. E. E.*)
♂ 1. Constantine, 15, vi, 94. (*A. E. E.*)
♂ 3. „ 8 and 16, vi, 94. (*F. D. M.*)
♀ 2. Between Azazga and Yakouren, on *Carlina racemosa*, 1, ix, 93. (*A. E. E.*)
♀ 2. Constantine, on *Inula viscosa*, 9, x, 93 and 15, x, 95. (*A. E. E.*)
♀ 1. Médéa, on *Scabiosa maritima*, 1, vii, 93. (*A. E. E.*)
♀ 2. Le Tarf, on *Cynara cardunculus*, 23, vii, 96. (*A. E. E.*)
♀ 2. Bône, 9, viii, 97. (*A. E. E.*)

MEGACHILE ARGENTATA.

♂ ♀. Many examples, vi, 93 to v, 97. Biskra, on *Peganum harmala* in April, and on *Ammi visnaga* in May and June, and on *Daucus setifolius* and *Mentha rotundifolia* in July. (*A. E. E.*)
Tizi Ouzou, on *Centaurea*, June. (*A. E. E.*)
Le Tarf, *Verbena officinalis* in July. (*A. E. E.*)
Médéa, on *Eryngium triquetrum*, July. (*A. E. E.*)
Azazga and Yakouren, on *Eryngium triquetrum* and *Carlina racemosa* in September. (*A. E. E.*)
Constantine, on *Inula viscosa*, October. (*A. E. E.*)
♂ ♀. Many, Constantine and Biskra, v and vi, 98, (*F. D. M.*)

MEGACHILE FLABELLIPES, Per.

♂ 2. Biskra, 13 and 20, iv, 95. (*A. E. E.*)
♀ 1. „ visiting *Traganum nudatum*, 3, iv, 95. (*A. E. E.*)
♀ 1. „ 28, iii, 95. (*A. E. E.*)
♀ 1. „ on *Diplotaxis pendula*, 30, iii, 97. (*A. E. E.*)

MEGACHILE XANTHOPYGA, Per.

♀ 1. Le Tarf, on *Verbena officinalis*, 24, vii, 96. (*A. E. E.*)

MEGACHILE ROTUNDATA, Fab.

♂ 1. Biskra, on *Ammi visnaga*, 24, v, 93. (*A. E. E.*)
♂ 1, ♀ 3. „ 4 and 19, v, 98. (*F. D. M.*)

MEGACHILE SCHNABLII, Rad. ?

♀ 1. Biskra, on *Ammi visnaga*, 15, vi, 97. (*A. E. E.*)

MEGACHILE FLAVIPES, Sm.

♂ 1, ♀ 3. Biskra, on *Ammi visnaga*, 20 to 26, v, 97. (*A. E. E.*)
♂ 1, ♀ 1. „ 23, v and 6, vi, 98. (*F. D. M.*)

LITHURGUS CHRYSURUS.

♂ 2. Tizi Ouzou, on *Centaurea*, 24, vi, 93. (*A. E. E.*)
♀ 3. Médéa, on *Centaurea calcitrapa* and *Microlonchus salmanticus*, 11 and 31, vii, 94. (*A. E. E.*)
♀ 1. Médéa, near Aine Souk, on *Mentha rotundifolia*, 21, vii, 93. (*A. E. E.*)
♂ 5, ♀ 5. Philippeville, 20, vi, 98. (*F. D. M.*)

OSMIA KOHLII, Ducke.

♂ 5, ♀ 5. Biskra, about walls of "adobe" in the village Negre, 13 and 23, ii, 94, and 19, ii, 97. (*A. E. E.*)
♂ 2. „ on *Periderea fuscata*, 15 and 21, ii, 95. (*A. E. E.*)
♀ 2. „ visiting *Antirrhinum ramosissimum*, 1, iii, 97. (*A. E. E.*)
♂ 1. Hippône, 3, iv, 96. (*A. E. E.*)
♂ 1. Bône, 2, iii, 96. (*A. E. E.*)
♂ 5, ♀ 1. Algiers, 17, iii to 14, iv, 95. (*F. D. M.*)

(Dr. Longstaff took á ♀ of this species at Biskra on an aromatic umbellifer, and another ♂ and ♀ on *Jasminium fruticans* at Hammam Rhirha, 30, iii, 05.)

OSMIA VIDUA, Gerst.

♂ 2. Biskra, on *Ammi visnaga*, 25 and 30, v, 93. "Eyes in life greenish-grey or greyish." (*A. E. E.*)
♂ 14. Algiers, 14, iii to 23, iv, 98. (*F. D. M.*)

OSMIA DIVES, Mocs.

♀ 2. Médéa, slopes of the Nador, on *Onopordon macracanthum*, 2, vii, 93. (*A. E. E.*)

Osmia tarfensis, n. sp.

O. viduæ affinis, nigra, vertice et mesonoto fulvo hirtis, thorace infra pallide hirto, abdominis segmentorum marginibus posticis fasciis angustis albo pubescentibus ornatis, scopa ventrali nigra.

♀. Black, vertex and thorax above clothed with fulvous hairs, face with a triangular patch of white hairs on each side, sides of the propodeum and thorax beneath clothed with very pale ochreous hairs, abdomen with a spot on each side of the basal segment almost meeting along the posterior margin and a narrow apical band on the next 4 segments, clothed with pale ochreous pubescence, 6th entirely clothed with whitish hairs, ventral brush black, legs clothed with pale hairs, calcaria dark pitchy, nearly black. Mandibles tridentate, more or less clothed outwardly with golden pubescence, clypeus regularly and closely punctured, rounded at the sides and more or less truncate in front, with a very slightly projecting angle where the sides meet the truncature. Antennæ with the 2nd joint of the flagellum nearly as long as the two following together, and about half as long again as the 1st, the rest of the joints subquadrate, looking rather longer than wide, mesonotum dull, very closely punctured, propodeal area shining, wings slightly brownish, abdomen slightly shining, closely and evenly punctured.

Long. 8 mm.

A small compact species, allied to *vidua* but quite different in the close puncturation, entire bands, etc.

♀ 7. Le Tarf, on *Cynara cardunculus*, 22 and 24, vii, 96, (*A. E. E.*)

Osmia decemsignata, Rad.

♀ 1. Biskra, on *Centaurea*, 3, v, 94. (*A. E. E.*)
♀ 1. „ on *Amberboa lippii*, 8, iv, 95. (*A. E. E.*)
♀ 1. Médéa, about to cut a leaf of *Cytisus*, 10, vii, 93. (*A. E. E.*)
♀ 2. „ on *Centaurea calcitrapa*, 12, vii, 93. (*A. E. E.*)
♀ 1. „ on dead herbage, 29, vii, 93. (*A. E. E.*)
♀ 1. Constantine on M'cid, visiting *Carduus pteracanthus*, 9, v, 95. (*A. E. E.*)
♀ 2. Algiers, 19, iv, 98. (*F. D. M.*)
♀ 1. Constantine, 18, vi, 98. (*F. D. M.*)

Osmia notata, F.

♂ 2, ♀ 2. Mustapha Supérieur, amongst *Centaurea seridis*, *Echium* and a *Labiate*, 4, v, 93. (*A. E. E.*)

♀ 1. Constantine on M'cid, on *Eryngium triquetrum*, 7, vi, 93. (*A. E. E.*)
♂ 1. Algiers, 4, iv, 98. (*F. D. M.*)
♀ 1. Philippeville, 20, vi, 98. (*F. D. M.*)

Osmia melanota, Mor.?

♀. Biskra, visiting *Retama retam*, 15, ii, 95. (*A. E. E.*)
♀. „ „ *Caligonum comosum*, 28, iii, 95. (*A. E. E.*)
♀ 4. „ on *Antirrhinum ramosissimum*, 21 and 29, iii, 97. (*A. E. E.*)
♀ 1. „ on *Amberboa lippii*.

An entirely black species with greyish hairs intermixed with black on the vertex of the head and the thorax.

Osmia latreillei, Spin.

♂ ♀. Biskra, many specimens, February to April.
♂. „ visiting *Periderea fuscata*, 15, ii, 94.
♂ 1, ♀ 2. „ „ *Amberboa lippii*, 11, iv, 95.
♀. „ nesting in "adobe" walls village Négre, 27, ii, 97. (*A. E. E.*)
♀. Fontaine Chaude, on *Tamarix pauciovulata*, 19, iv, 94. (*A. E. E.*)
♂ 2. Bône, 2 and 16, iii, 96. (*A. E. E.*)
♂ 5, ♀ 3. Algiers, 14, iii to 19, iv, 98. (*F. D. M.*)

Osmia fulviventris, Pz.

♂ 4. Algiers, 4 to 25, iv, 98. (*F. D. M.*)

Osmia leaiana, Kirb.

♂ 1. Bône, 15, v, 96. (*A. E. E.*)
♀ 1. Le Tarf, 16, vi, 96. (*A. E. E.*)

Osmia cærulescens, L.

♂ 3. Bône, 2 to 26, iii, 96. (*A. E. E.*)
♂ 1, ♀ 1. Hippône, 8, iii and 3, iv, 96. (*A. E. E.*)
♀ 4. Bône, on *Echium italicum*, 6, iv and 1, v, 96. (*A. E. E.*)
♀ 1. Biskra, on *Antirrhinum ramosissimum*, 21, iii, 92. (*A. E. E.*)
♂ 8. Algiers, March and April 98. (*F. D. M.*)
♂ 1. Constantine, 17, vi, 98. (*F. D. M.*)
♀ 13. Algiers, 12 to 30, iv, 98. (*F. D. M.*)

Osmia punica, Per.

♂ 7. Algiers, 4 to 14, iv, 98. (*F. D. M.*)

Osmia submicans, Mor.

♀ 1. Constantine, on *Thymus lanceolatus* var. *Kabylicus*, 11, vi, 94. (*A. E. E.*)
♂ 5, ♀ 1. Algiers, 14, iii to 5, iv, 98. (*F. D. M.*)
♂ 1. Le Tarf, 26, iii, 96. (*A. E. E.*)

Osmia lobata, Friese.

♂ 1. Algiers, 7, iv, 98. (*F. D. M.*)

Osmia gallarum, Spin.

♂ 4. Algiers, 6 to 23, iv, 98. (*F. D. M.*)

Osmia versicolor, Ltr.

♂ 1. Constantine on M'cid, 14, v, 95. (*A. E. E.*)

Osmia ferruginea, Ltr.

♀ 5. Bône, a snail-shell species, visits *Senecio leucanthemifolius*, 23, iii, 96. (*A. E. E.*)
♀ 2. „ along the coast, on *Erodium* and *Lotus prostratus*, 9, iv, 96. (*A. E. E.*)
♂ ♀. Algiers, many examples, 11 to 22, iv, 98. (*F. D. M.*)

Osmia andrenoides, Spin.

♂ 2, ♀ 1. Constantine, 16 and 17, vi, 98. (*F. D. M.*)
♀ 1. Algiers, 29, iv, 98. (*F. D. M.*)

Osmia, sp. ?

♀ 1. Le Tarf, 23, vi, 96. (*A. E. E.*)

A peculiar species in the form of the clypeus which is somewhat bilobed at the apex, and has a deep impression on each side near the base where it joins the cheek. In general appearance it rather resembles a small *bidentata* but the scutellum is simple. I refrain from describing it as I have only seen a single ♀.

Osmia rufigastra, Lep.

♂ 1, ♀ 6. Algiers, 30, iv, 98. (*F. D. M.*)

Osmia tricolor, n. sp.

Nigra, clypei apice, vertice, mesonoto et postscutello læte fulvo-hirtis, clypei basi, thoracis et propodei lateribus niveo hirtis, area propodeali nitida. Abdomen nitidum punctatum, marginibus posticis fasciis latis, in segmentis 1, 2, 3 late interruptis in 4 et 5 completis niveis ornatis, scopa albida.

♀. Black. Mandibles outwardly, apex of clypeus, vertex, mesonotum including the scutellum, and also the postscutellum clothed with bright fulvous red hairs, base of the clypeus, face, thorax at the sides and sides of the propodeum, a short, rather wide lateral band at the apex of the 1st, 2nd and 3rd abdominal segments, and an entire band on the 3rd and 4th clothed with snowy-white hairs, wings dusky, nervures rufo-testaceous at the base, brown otherwise, tegulæ bright rufo-testaceous, legs clothed with white hairs, apical joints of the tarsi testaceous, ventral brush whitish. Head closely punctured, mandibles tridentate, antennæ short, 1st joint of the flagellum longer than the 2nd, 2nd wider than long, 3rd twice as wide as long, the following joints lengthening in their proportions the penultimate joint nearly quadrate, surface of thorax where visible slightly shining, largely punctured, the punctures nearly as wide as the intervals, propodeal area shining; abdomen shining finely punctured.

Long. 6½–7 mm.

A small compact species, whose colour will distinguish it from any other which I can find described.

♀ 3. Biskra, on *Reseda*, 21, iii, 97. (*A. E. E.*)

Osmia moricei, Friese.

♂ 2. Biskra, Route des Ziban, on *Ammi visnaga*, 18, v, 93. (*A. E. E.*)

♀ 1. „ grounds of Château Laudon, on *Ammi visnaga*, "eyes sap green," 24, v, 93. (*A. E. E.*)

♀ 1. „ road to Hamman es Salahin, visiting *Peganum harmala*, 22, iv, 95.

♀ 1. „ near railway, Kilom. 199, 12, iv, 95. (*A. E. E.*)

♂ 3, ♀ 8. „ 4 to 7, v, 98. (*F. D. M.*)

Osmia transcaspica, Mor.

♂ 2, ♀ 9. Biskra, on *Antirrhinum ramosissimum*, 1, iii and 21, iii, 97. (*A. E. E.*)

Osmia lævifrons, Mor.

♂ 1, ♀. Biskra, in the grounds of Château Landon, 8 to 10 a.m. "♂ eyes greenish in life ♀ whitish-grey," 24, v, 93. (*A. E. E.*)
♂ 1. „ near Kilom. 199, visiting *Amberboa lippii*, 8, iv, 95. (*A. E. E.*)
♂ 1, ♀ 1. „ 9, v, 98. (*F. D. M.*)

Osmia rubricrus, Friese.

♂ 1, ♀ 1. Biskra, Fontaine Chaude, on the Dunes near the stream, on *Limoniastrum Guyonianum*, 9, v, 94. (*A. E. E.*)
♂ 5, ♀ 3. „ near railway, Kilo 199, among bushes of *Limoniastrum Guyonianum* and *Nitraria tridentata*. Eyes black or brownish; "burrows in sandy soil rather caked on the surface after rain," 21, iv, 95 and 8 to 25, iv, 97. (*A. E. E.*)
♂ 4, ♀ 12. „ 6 to 19, v, 98. "This *Osmia* nests in flat sand and like *papaveris* lines its cells with pink flowers of a tall shrub." (*F. D. M.*)

Both Mr. Eaton and Mr. Morice found *Paradioxys moricei* associating with this species.

Osmia bisulca, Gerst.

♀ 1. Médéa, on *Eryngium triquetrum*, 29, vi, 93. (*A. E. E.*)

Osmia saundersii, Vach.

♀ 1. Sidi Ferruch, 8, v, 93. (*A. E. E.*)
♀ 1. Le Tarf, on *Centaurea napifolia*, 17, vi, 96. (*A. E. E.*)
♂ 1. Biskra, 26, ii, 97. (*A. E. E.*)
♂ 8, ♀ 6. Algiers, 6 to 30, iv, 98. (*F. D. M.*)

Osmia crenulata, Mor.

♂ 2, ♀ 4. Biskra, on *Antirrhinum ramosissimum*, 21 and 29, iii, 97. (*A. E. E.*)
♀ 1. Constantine, on *Echium italicum*, 21, v, 95. (*A. E. E.*)

♀ 1. Biskra, on *Amberboa lippii*, 8, iv, 97. (*A. E. E.*)
♀ 1. „ on *Limoniastrum feei*, 16, iv, 95. (*A. E. E.*)

OSMIA VAULOGERI, Per.?

♂ 2. Algiers, 19, iv, 98. (*F. D. M.*)

OSMIA FERTONII, Per.

♂ 6, ♀ 4. Algiers, 20 to 30, iv, 98. (*F. D. M.*)

OSMIA SPINOLÆ, Schk.

♂ ♀. Numerous. Algiers, iii and iv, 98. *F. D. M.*

OSMIA, sp. ?

♀ 1. Biskra, 13, iv, 95. (*A. E. E.*)

Allied to *Spinolæ* but clypeus with a distinct central carina.

OSMIA MORAWITZI, Per.

♂ 1. Constantine, on *Thapsia garganica*, 19, v, 95. (*A. E. E.*)
♂ 1. „ on *Echium italicum*, 21, v, 95. (*A. E. E.*)
♀ 3. Bône, on *Echium italicum*, 6, iv, 96. (*A. E. E.*)
♀ 2. „ 9, iii and 14, v, 96. (*A. E. E.*)
♀ 1. Azazga, alt. about 1,420 ft., 13, vi, 93. (*A. E. E.*)
♂ ♀. Many specimens, Algiers, iii and iv, 98. (*F. D. M.*)

OSMIA ADUNCA, Pz.

♂ 4. Algiers, on *Echium*, 5, iv, 93. (*A. E. E.*)
♂ 3. Constantine, on *Echium*, 23, v, 95. (*A. E. E.*)
♂ 3. „ 22, v, 95. (*A. E. E.*)
♂ 2, ♀ 1. „ on *Echium*, 29, v, 95. (*A. E. E.*)
♀ 1. Hussein Dey, on *Echium*, 4, iv, 93. (*A. E. E.*)
♀ 1. Mustapha Supérieur, on *Echium*, 4, v, 93. (*A. E. E.*)

OSMIA LEPELETIERII, Per.

♀ 1. Constantine, on *Echium italicum*, 21, v, 95. (*A. E. E.*)

OSMIA, sp. ?

♀ 1. Constantine, visiting *Echium italicum*, 21, v, 95. (*A. E. E.*)

One of the *adunca* group but with a very finely and closely punctured abdomen.

Osmia, sp. ?

♂ 1. Biskra, 13, iv, 95. (*A. E. E.*)

Another of the *adunca* group, but impossible from a single specimen to locate for certain. *Calcaria* pale.

Osmia lativentris, Friese.

♂ 2, ♀ 1. Algiers, 14 and 23, iv, 98. (*F. D. M.*)

Osmia, sp. ?

♀. Constantine, on *Echium italicum*, 21, v, 95. (*A. E. E.*)

A species resembling the *adunca* group but with pale *calcaria* and large bright and shining propodeal area.

Osmia epeoliformis, Ducke.

♀ 1. Biskra. "Eyes blackish or brownish-black." 13, iv, 95. (*A. E. E.*)
♀ 2. „ on *Atractylis serratuloides*, 13, v, 97. (*A. E. E.*)

Osmia gracilicornis, Per.

♀ 5. El Guerrah, 3, v. 93. (*F. D. M.*)

Osmia tunensis, Lep.

♀ 1. Constantine, visiting *Silybum marianum* and *Galactites tomentosa*, 7, v, 95.
♀ 1. „ visiting *Galactites tomentosa*, 15, v, 95. (*A. E. E.*)

Osmia dissimilis, Friese.

♂ 1. Algiers, on *Echium*, 18, iv, 93. (*A. E. E.*)
♂ 3, ♀ 1. Bône, 9, iii to 26, v, 96. (*A. E. E.*)
♀ 1. Constantine, 2, vi, 95. (*A. E. E.*)
♀ 1. „ visiting thistles, 18, v, 95. (*A. E. E.*)
♀ 1. „ visiting *Phlomis herba-venti*, 19, v, 95. (*A. E. E.*)

Osmia aurulenta, Pz.

♀ 1. Médéa, on *Onopordon macracanthum*, 4, vii, 93. (*A. E. E.*)

Osmia fossoria, Per.

♂ 1, ♀ 1. Bône, visiting *Senecio leucanthemifolius*, 23, iii, 96. (*A. E. E.*)
♀ 1. „ inhabits snail-shells, 4, iii, 96. (*A. E. E.*)
♀ 1. „ 26, v, 96. (*A. E. E.*)
♂ 1, ♀ 1. „ 13, iv, 03. (*A. E. E.*)
♂ 2. Algiers, 29 and 30, iv, 98. (*F. D. M.*)

Osmia acuticornis, Duf. and Perr.

♂ 1. Algiers, 12, iv, 95. (*F. D. M.*)

Osmia diversa, Friese (MS.) ?

♀ 1. Biskra, 6, v, 91. (*F. D. M.*)

Osmia rufiscopa, Friese.

♀ 2. Biskra, 6, v, 98. (*F. D. M.*)

Osmia freygessneri, Friese.

♂ 2, ♀ 1. Biskra, near railway, Kilom. 199, 13, iv, 95. (*A. E. E.*)
♂ 6, ♀ 4. „ 4 to 11, v, 98. (*F. D. M.*)

Osmia hartliebi, Friese.

♂ 1. Fontaine Chaude, 31, iii, 94. (*A. E. E.*)

Osmia parvula, Duf. and Perr.

♀ 1. Constantine, 6, vi, 95. (*A. E. E.*)

Osmia nasuta, Friese.

♀ 1. Biskra, 9, v, 98. (*F. D. M.*)

Osmia pinguis, Per.

♂ 1. Biskra, near railway, Kilom. 199, visiting *Amberboa lippii*, 8, iv, 95. (*A. E. E.*)
♂ 1. La Calle, 4, vii, 96. (*A. E. E.*)

Osmia bidentata, Mor.

♀ 1. Tizi Ouzou, Mount Beloua towards the Monument by the path to Maison Forestier, 4, vi, 93. (*A. E. E.*)

Osmia exenterata, Per.

♀ 1. Constantine, visiting *Nigella sativa*, 2, vi, 95. (*A. E. E.*)
♂ 1. Algiers, 14, iv, 98. (*F. D. M.*)
♂ 1. El Guerrah, 3, v, 98. (*F. D. M.*)

Eriades truncorum, L.

♂ 1. La Calle, on *Echium*, 9, vii, 96. (*A. E. E.*)
♂ 1. Sidi Ferruch, on *Echium*, 8, v, 93. (*A. E. E.*)

Eriades rubicolus, Per.

♂ 1. Azazga, 30, viii, 93. (*A. E. E.*)
♀ 2. Biskra, 3, vi, 93 and 7, v, 97. (*A. E. E.*)
♀ 3. Médéa, near Damiette, on *Pulicaria dysenterica*, 5, vii, 93. (*A. E. E.*)
♀ 1. Bône, 10, viii, 97. (*A. E. E.*)

Anthidium interruptum, F.

♂ 1. Sidi Ferruch, on *Echium*, 8, v, 93. (*A. E. E.*)
♂ 2. La Calle, visiting *Scabiosa rutæfolia*, 18, vii, 96. (*A. E. E.*)
♂ ♀. La Calle, 19, vii, 96. (*A. E. E.*)
♂. Le Tarf, 17, vi, 96. (*A. E. E.*)

Anthidium laticeps, Mor.

♂ 1. Constantine, 11, vi, 94. (*A. E. E.*)

Anthidium bellicosum, Lep.

♀ 2. La Calle, 4 and 8, vii, 96. (*A. E. E.*)
♀ 1. Biskra, Col de Sfa, on *Teucrium polium*. Eyes in life reddish olive-brown. 2, vi, 93. (*A. E. E.*)

Anthidium afrum, Lep.

♂ 1. Médéa, under Kef-el-Ahmeur up to 2,300 ft., on *Carlina racemosa*, 17, viii, 93. (*A. E. E.*)
♀ 1. Tizi Ouzou, on the slopes of Mount Belona, on *Echinops*, 14, vi, 93. (*A. E. E.*)
♀ 1. Biskra, 30, v, 97. (*A. E. E.*)
♂ 1. „ 31, v. 98. (*F. D. M.*)

Anthidium ferrugineum, F.

♀ 1. La Calle, 19, vii, 96. (*A. E. E.*)

ANTHIDIUM LATREILLEI, Lep.

♂ 2, ♀ 2. Médéa, on *Eryngium triquetrum*, 26 and 28, vi, 93. (*A. E. E.*)
♂ 1. Constantine, on *Atractylis gummifera*, 1, x, 93. (*A. E. E.*)
♂ 3, ♀ 2. Biskra, 28, v, 93 and 12 to 19, v, 97. (*A. E. E.*)
♂ 3. „ on *Atractylis serratuloides* and *Ammi visnaga*, 13 and 31, v, 97. (*A. E. E.*)
♂ 1. „ on *Eryngium ilicifolium*, 18, vii, 97. (*A. E. E.*)
♂ 3, ♀ 8. „ 23, v to 6, vi, 98. (*F. D. M.*)

ANTHIDIUM STICTICUM, F.

♂ 2, ♀ 1. Algiers, Hussein Dey, 4 and 15, iv, 93. (*A. E. E.*)
♀ 1. „ Colonne Voirol, 4, v, 93. (*A. E. E.*)
♂ 1, ♀ 1. Constantine, on *Onobrychis venosa*, 12, vi, 94. (*A. E. E.*)
♀ 1. Bône, 16, iii, 96. (*A. E. E.*)
♂ 4, ♀ 9. Algiers, 6 to 30, iv, 98. (*F. D. M.*)

ANTHIDIUM SICULUM, Spin.

♂ 3, ♀ 1. Constantine, on M'cid, a common species visiting *Centaurea*, thistles and *Convolvulus tricolor*, 13, v, 95. (*A. E. E.*)
♀ 2. Bône, 16, iii and 1, v, 96. (*A. E. E.*)
♀ 1. Constantine, visiting *Silybum marianum* and *Galactites tomentosa*, 7, v, 95. (*A. E. E.*)
♂ 1. Algiers, 30, iv, 98. (*F. D. M.*)
♀ 2. Constantine, 15, iv, 98. (*F. D. M.*)

ANTHIDIUM STRIGATUM, Pz.

♂ 2, ♀ 1. Constantine, on *Daphne gnidum*, 4, x, 93. (*A. E. E.*)
♀ 1. „ on *Ononis viscosa*, 6, vi, 95. (*A. E. E.*)
♂ 1. Le Tarf, on *Verbena officinalis*, 24, vii, 96. (*A. E. E.*)
♂ 1. Biskra, on *Atractylis serratuloides*, 11, v, 97. (*A. E. E.*)
♂ 1. „ on *Ammi visnaga*, 28, v, 97. (*A. E. E.*)

ANTHIDIUM MANICATUM, L.

♂ 1. Algiers, 3, v, 93. (*A. E. E.*)
♂ 1. Constantine, 10, vi, 95. (*A. E. E.*)

♂ 1. Médéa, on *Centaurea calcitrapa*, 12, vii, 93. (*A. E. E.*)
♀ 1. Mustapha Supérieur, on *Echium*, 4, v, 93. (*A. E. E.*)

Anthidium diadema, Ltr.

♂ 2. Médéa, route d'Alger, on *Centaurea nicæensis* and *Scabiosa maritima*, 26, vi, 93. (*A. E. E.*)
♂ 1, ♀ 1. Between Médéa and Lodi, on *Centaurea calcitrapa*, alt. about 2,980 ft, 12, vii, 93. (*A. E. E.*)
♂. Médéa, under Ke-el-Ahmeur, on *Eryngium tricuspidatum*. "Colour when alive wasp-yellow, 17, viii, 93. (*A. E. E.*)
♂ 2. „ near Aine Souk, 29, vii, 93. (*A. E. E.*)

Anthidium konovii, Friese.

♀. Philippeville, 20, vi, 98. (*F. D. M.*)
♀. Constantine, 4, vi, 98. (*F. D. M.*)

Anthidium affine, Mor.

♂ 2. Médéa, near Md. Ben Omar, alt. about 3,130 to 2,370 ft., on *Eryngium triquetrum* and *Scabiosa maritima*, 11, vii, 93. (*A. E. E.*)

Anthidium affine, var. *monile*, Ill.

♂ 1. Médéa, on *Mentha rotundifola*, 19, vii, 93. (*A. E. E.*)
♀ 1. Le Tarf, on *Verbena officinalis*, 24, vii, 96. (*A. E. E.*)

Anthidium cingulatum, Ltr.

♂ 1. Médéa, on *Eryngium triquetrum*, 27, vi, 93. (*A. E. E.*)
♂ 1. „ on *Onopordon macracanthum*, 2, vii, 93. (*A. E. E.*)
♂ 2. „ on *Inula viscosa*, 9, x, 93. (*A. E. E.*)

Anthidium lituratum, Pz.

♂ and ♀. Numerous specimens visiting *Onopordon macracanthum*, *Centaurea calcitrapa*, *Verbena officinalis* at Médéa in July; *Amberboa lippii*, *Ferula vesceritensis*, *Atractylis serratuloides* and *Tamarix* at Biskra in April and May; *Cynara cardunculus* at Le Tarf in July. (*A. E. E.*)

ANTHIDIUM RETICULATUM, Mocs.

♂ 1. Between Médéa and Lodi, alt. about 2,809 ft., on *Centaurea calcitrapa*, 12, vii, 93. (*A. E. E.*)

ANTHIDIUM STIGMATICORNE, Drs.

♀ 1. Biskra, north of railway, Kilom. 199, on *Teucrium polium*, 28, v, 94. (*A. E. E.*)
(4th and 5th joints of the antennæ testaceous.)

STELIS ATERRIMA, Pz.

♂ 1, ♀ 3. Philippeville, 20, vi, 98. (*F. D. M.*)

STELIS CASSIOPÆA, n. sp.

S. phœopteræ affinis, facie magis rotundata, capite thoraceque opacis, densissime punctatis facile distinguenda.

♂|♀. So closely allied to *phœoptera*, K., that it will only be necessary to point out its differential characters. The head and thorax are much more closely punctured so that their surface is quite dull, and they are more evenly and closely clothed with grey hairs, the abdomen on the other hand in the ♀ is less closely though quite as largely punctured especially on the 3rd segment. The abdominal puncturation in the males of both species is very similar, but the 6th segment in the ♂ of *phœoptera* has a stronger apical angle. In both sexes of the new species the face is broader and therefore rounder and in the ♀ the eyes are more convergent.

Long. 7–8 mm.

♂ 2. Biskra, near Kilom. 199, visiting *Amberboa lippii*, 12, iv, 95. (*A. E. E.*)
♀ 1. „ above the barrage, visiting *Amberboa lippii*, 8, iv, 97. (*A. E. E.*)
♀ 1. „ flying about "adobe" house walls, 27, ii, 97. (*A. E. E.*)
♂ 1. Bône, 30, iv, 96. (*A. E. E.*)

STELIS NASUTA, Ltr.

♂ 1, ♀ 1. Constantine, 13, v, 95. (*A. E. E.*)

STELIS VACHALI, Per.

♂ 1. Biskra, visiting *Antirrhinum ramosissimum*, 29, iii, 97. (*A. E. E.*).
♀ 1. „ on *Atractylis serratuloides*, 13, v, 97. (*A. E. E.*)

STELIS, sp. ?

♀ 1. Le Tarf, visiting heads of *Cynara cardunculus*, 23, vii, 96. (*A. E. E.*)

Allied to *signata*.

STELIS, sp. ?

♂ 1. Biskra, amongst *Tamarix*, 4, iv, 97. (*A. E. E.*)

EUCERA (*Macrocera*) RUFICOLLIS, Brullé.

♂ 1. Constantine, on *Carduus macrocephalus*, 28, v, 95. (*A. E. E.*)

EUCERA (*Macrocera*) ALTERNANS, Brullé.

♂ 1, ♀ 1. Constantine, on *Alkanna tinctoria*, 28, v, 95. (*A. E. E.*)

♀ 2. „ on *Anchusa* and *Salvia patula*, 12, vi, 94. (*A. E. E.*)

♂ 9, ♀ 1. Algiers, 14 to 29, iv, 98. (*F. D. M.*)

EUCERA (*Macrocera*) TRICINCTA, Ev.

♂ 5, ♀ 5. Biskra, on *Peganum harmala*. "Eyes of ♂ sap-green," 3 and 29, v, 94, 22, iv, 95 and 3, iv, 97. (*A. E. E.*)

♀ 7. „ 5 to 14, v, 98. (*F. D. M.*)

EUCERA (*Macrocera*) CUNICULARIA, Kl.

♂ 14, ♀ 10. Biskra, 1 ♀ visiting *Moricandia arvensis*, 14 ♂ and 8 ♀ visiting *Amberboa lippii*, 11 to 27, iv, 95 and 10, ii to 26, iii, 97. "Eyes light greenish or light yellowish-green." (*A. E. E.*)

♀. „ numerous specimens 6 to 9, v, 98. (*F. D. M.*)

EUCERA (*Macrocera*), sp. ?

♂ 2. Médéa, in bad condition on *Scabiosa maritima*, 1, vii, 93. (*A. E. E.*)

EUCERA (*Macrocera*) CINCTELLA, n. sp.

Tricinctæ affinis, sed minor, mas clypeo toto nigro, femina seg-

mentorum abdominalium apicibus concoloribus et fasciis angustoribus ornatis, distincta.

Apparently allied to *tricincta*, Ev. on account of the white apical bands of the abdominal segments, but it is a smaller and darker species and the apices of the segments are black.

♂. Face, clypeus and labrum entirely black, antennæ reaching to about the apex of the 2nd abdominal segment, vertex and mesonotum clothed with ochreous-brown hairs, wings slightly clouded, thorax beneath and propodeum clothed with paler whitish hairs. Abdomen dull, very closely punctured, basal segment clothed especially at the base with ochreous-white hairs, 2nd and following segments each with a rather narrow apical band of white hairs, apical dorsal valve punctured at the base and clothed with golden hairs towards the apex which is rounded, 6th segment with an angular tooth on each side at the apex, segments beneath shining, punctured, their posterior margins rather widely piceous, legs simple, clothed with white hairs.

♀. Face clothed with white hairs, 1st joint of the flagellum about equal in length to the 2 following together, mesonotum clothed with rather bright brown hairs, thorax beneath and propodeum clothed with nearly white ones, abdomen closely punctured, basal segment clothed with ochreous hairs on its anterior half, its apical margin smooth and shining, 2nd and following segments with a narrow apical band of white hairs, that of the 5th golden in the centre, and the 2nd also with a line of white hairs on each side at the base, apical dorsal valve small, finely and transversely rugulose, legs clothed with white hairs.

Long. 11–12 mm.

♂ 1, ♀ 1. La Calle, 19, vii, 96. (*A. E. E.*)
♀ 1. Tizi Ouzou, Mount Beloua, alt. about 1,700 ft., on *Calamintha*, 15, vi, 93. (*A. E. E.*)

EUCERA (*Macrocera*) BRACHYCERA, Grib.

♂ 1. Biskra, visiting *Antirrhinum ramosissimum*, 21, iii, 97. (*A. E. E.*)

This ♂ agrees well with Gribodo's description. Friese when he wrote his monograph of the Palæarctic species did not know it.

EUCERA (*Macrocera*) DENTATA, Klug.

♂ 1. Biskra, visiting *Limoniastrum guyonianum*, 6, v, 97. (*A. E. E.*)
♂ 1. „ 23, v, 98. (*F. D. M.*)

EUCERA (*Macroccra*) GRAJA, Ev.

♂ 6, ♀ 2. Le Tarf, abundant on *Cynara cardunculus*, eyes in life sub-cæsius, 28, vi and 23, vii, 96. (*A. E. E.*)

♂ 2. „ on *Centaurea napifolia*, 27, vi, 96. (*A. E. E.*)

EUCERA (*Macroccra*) COMMIXTA, D. T.

♂ 3. Constantine, 13, vi, 98. (*F. D. M.*)

EUCERA (*Macroccra*) sp.?

♀ 1. Le Tarf, 24, vi, 96. (*A. E. E.*)

EUCERA (*Macroccra*) POLLINOSA, Lep.?

♂ 1. La Calle, 15, vii, 96. (*A. E. E.*)

EUCERA (*Macroccra*) LYNCEA, Mocs.

♀ 2. Between Médéa and Lodi, on *Centaurea calcitrapa*, alt. 2,980 ft., 12, vii, 93. (*A. E. E.*)

EUCERA (*Macroccra*) RUFICORNIS, F.

♂ 4, ♀ 2. Azazga, main road towards the European Cemetery and mule-track to the right beyond. The *Eucera* was flying in some numbers about the rudiments of a dead hedge and the border of the mule-track, 30, viii, 93. (*A. E. E.*)

♀ 2. „ Forêt de Yakouren, on *Carlina racemosa*, 12 to 19, ix, 93. (*A. E. E.*)

♀ 1. Var. with clypeus almost entirely black. La Calle, 9, vii, 96. (*A. E. E.*)

♂ 2. Philippeville, 20, vi, 98. (*F. D. M.*)

EUCERA (*Macroccra*) STRIGATA, Lep.

♂ 2. Tizi Ouzou, just over the ridge of Mount Beloua, about 1,700 ft., on *Calamintha*, 15, vi, 93. (*A. E. E.*)

EUCERA LONGICORNIS, L. = *difficilis*, Per.

♂ 1. Bône, 15, iii, 96. (*A. E. E.*)

♀ 1. var. (?) Algiers, on *Antirrhinum ramosissimum*, 6, iv, 93. (*A. E. E.*)

EUCERA, sp.?

♂ 1. Biskra, on *Antirrhinum ramosissimum*, 1, iii, 97. (*A. E. E.*)

Like *longicornis* but labrum black and apical segments dull.

EUCERA ALGIRA, Lep.

♀ 1. Algiers, 6, iv, 93. (*A. E. E.*)

Dr. Longstaff took a ♂ at flowers of *Spergula*, at El Outaia, 1, iii, 05.

EUCERA CLYPEATA, Er.

♂ 1. Bône, Route de l'Edough, 7, iii, 96. (*A. E. E.*)
♂ 1. „ 9, v, 96. (*A. E. E.*)
♀ 1. Mustapha Supérieur, amongst *Centaurea scridis*, *Echium* and a *Labiate*, 4, v, 93. (*A. E. E.*)
♀ 1. Constantine, visiting *Silybum marianum* and *Galactites tomentosa*, 7, v, 95. (*A. E. E.*)

EUCERA NIGRIFACIES, Lep.

♂ 1. Algiers, on *Echium*, 4, iv, 93. (*A. E. E.*)
♀ 1. Médéa, on *Centaurea nicæensis* and *scabiosa*, 26, vi, 93. (*A. E. E.*)

EUCERA EUCNEMIDEA, Dours.

♂ 1. Constantine, visiting *Silybum marianum* and *Galactites tomentosa*, 7, v, 95. (*A. E. E.*)
♂ 2, ♀ 3. „ ♂ on *Carduus pteracanthus*, ♀ on *Hypochæris glabra*, 9, v, 95. (*A. E. E.*)
♂ 1. „ on *Convolvulus tricolor*, 14, v, 95. (*A. E. E.*)
♂ 1. Biskra, on *Amberboa lippii*, 11, iv, 95. (*A. E. E.*)
♀ 1. Médéa, on *Centaurea*, 26, vi, 93. (*A. E. E.*)
♀ 2. Constantine, 18, vi, 98. (*F. D. M.*)

EUCERA CASPICA, Mor.

♀ 3. Algiers, 9 to 23, iv, 98. (*F. D. M.*)

EUCERA SAUNDERSII, Friese.

♂ 5. Algiers, one on *Echium*, 9, iii to 4, iv, 93. (*A.E.E.*)
♂ 8, ♀ 6. „ 14, iii to 30, iv, 98. (*F. D. M.*)

♂ 3. Biskra, garden of Château Landon, 13, ii, 94. (*A. E. E.*)
♂ 9, ♀ 1. „ Left of Route de Tougourt a little beyond Château Landon, on *Peridercа fuscata*, 21, ii, 95. (*A. E. E.*)
♀ 2. Constantine on M'cid, visiting *Hypochæris glabra*. 9, v, 95. (*A. E. E.*)
♀ 1. „ visiting *Convolvulus tricolor*, 13, v, 95. (*A. E. E.*)
♀ 3. Bône, 6, iv to 10, vi, 96. (*A. E. E.*)
♂ 3. „ visiting low plants such as *Diplotaxis, Linaria reflexa* and often patches of *Arisarum vulgare*. 15 to 16, iii, 96. (*A. E. E.*)

Eucera notata, Lep.

♂ 3, ♀ 2. Algiers, on *Echium*, 9, iii to 6, iv, 93, (*A. E. E.*)
♂ 12, ♀ 14. „ 14, iii to 23, iv, 98. (*F. D. M.*)
♂ 1, ♀ 2. Bône, 18 to 23, iv, 96, (*A. E. E.*)
♀ 1. Constantine on M'cid, visiting *Carduus pteracanthus*, 9, v, 95. (*A. E. E.*)

Eucera grisea, F.

♂ 1, ♀ 6. Biskra, on *Amberboa lippii*, 11, 12, iv, 95, and 8 and 13, iv, 97. (*A. E. E.*)
♀ 3. „ on *Ammi visnaga*, 28, v, 94 and 27, v, 97. (*A. E. E.*)
♀ 1. Constantine, on *Galactites tomentosa*, 15, v, 95. (*A. E. E.*)
♀ 4. Biskra, 6, v to 11, vi, 98. (*F. D. M.*)
♀ 2. Algiers, 18, iii to 27, iv, 98. (*F. D. M.*)

Eucera trivittata, Brullé.

♂ 1. Algiers, on *Echium*, 4, iv, 93. (*A. E. E.*)
♀ 1. „ on *Asteriscus maritimus*, 10, v, 93. (*A.E.E.*)
♀ 4. Médéa, on *Eryngium triquetrum*, 26 to 28, vi, 93, and *Scabiosa maritima*, 1, vii, 93. (*A. E. E.*)
♀ 3. Azazga, alt. about 1,420 ft., on *Echium*, 13, vi, 93. (*A. E. E.*)
♀ 1. Mustapha Supérieur, amongst *Centaurea, Echium* and a *Labiate*, 4, v. 93. (*A. E. E.*)
♂ 18, ♀ 5. Algiers, 18, iii to 27, iv, 98. (*F. D. M.*)

The specimens from Azazga and Mustapha Supérieur are much larger than the others, but they have been determined by Herr Friese as *trivittata*.

EUCERA NIGRILABRIS, Lep.

♂ 3, ♀ 4. Biskra, 1 ♂, on *Acanthyllis tragacanthoides*, 1 ♂ on *Calendula arvensis*, the rest on *Moricandia arvensis*, 2 to 8, ii, 94, 25, ii, 95, 4 to 11, ii, 97. (*A. E. E.*)

All in perfect condition with bright fulvous hairs on the base of the abdomen.

♂ ♀. Biskra, various specimens, on *Moricandia arvensis*, ii and iii, 95, 96 and 97. (*A. E. E.*)

♂ 4, ♀ 4. Bône, sandy ground skirting the sea-shore, visiting *Alkanna tinctoria*, all very melanic, 4 and 9, iii, 96. (*A. E. E.*)

EUCERA NIGRILABRIS, Lep. var. ?

♂ 1. Biskra, on *Retama retam*, 15, ii, 95. (*A. E. E.*)

Pale hairs extending over the whole surface of the abdomen. I am indebted to Herr Friese for this determination.

EUCERA FERRUGINEA, Lep.

♂ 6, ♀ 2. Bône, visiting *Lavendula stœchas*, 29, iv to 25, v, 96. (*A. E. E.*)

♀ 4. Aine Kriar, visiting *Linaria reticulata*, 20 to 22, vi, 96. (*A. E. E.*)

EUCERA ATRICORNIS, F.

♂ 3, ♀ 4. Algiers, near Mustapha Supérieur, in a field a little beyond Colonne Voirol, amongst *Centaurea*, *Echium*, and a *Labiate*, 6, iv and 4, v, 93. (*A. E. E.*)

♂ 9, ♀ 1. „ 14 to 23, iv. 98. (*F. D. M.*)

EUCERA HISPANA, Lep.

♂ 2. Constantine, visiting *Carduus macrocephalus*, 17, 18, v, 95. (*A. E. E.*) In brilliant condition

♂ 1. Bône, 23, v, 96. (*A. E. E.*) In brilliant condition.

♂ 1. Constantine, on *Scabiosa maritima*, 16, vi, 94, faded. (*A. E. E.*)
♂ 1, ♀ 2. Aine Draham, on *Centaurea melitensis*, 20, vii, 96, faded. (*A. E. E.*)
♀ 2. Le Tarf, on *Centaurea napifolia*, 16 and 17, vi, 96. (*A. E. E.*) In brilliant condition.
♀ 3. Médéa, on *Centaurea calcitrapa*, 26, vi and 5, vii, 93, faded. (*A. E. E.*)
♂ 4, ♀ 6. Algiers, 31, iii to 27, iv, 98. (*F. D. M.*)

Eucera aterrima, Friese.

♀ 1. Algiers, El Biar, on *Echium*, 20, iii, 93. (*A. E. E.*)
♀ 3. Bône, 4, 23, v, 96. (*A. E. E.*)
♀ 1. Algiers, 24, v, 98. (*F. D. M.*)

Eucera numida, Lep.

♀ 1. Bône, 7, iii, 96. (*A. E. E.*)
♀ 1. Hippône, 17, iii, 96. (*A. E. E.*)
♀ 11. Algiers, 29, iii to 27, iv, 98. (*F. D. M.*)

Eucera dentipes, sp. nov.

♂. Nigra, pilis obscuro-ochraceis dense vestita, abdominis segmentorum marginibus posticis dilutioribus, femoribus intermediis, subtus prope basin dentatis.

♂. About the size of *longicornis* and clothed much as *grisea* ♂ clypeus and labrum entirely black, antennæ rather slender, the 2nd joint of the flagellum rather longer than wide, body entirely clothed with dull ochreous hairs, those of the margins of the segments rather paler, so as to show as narrow bands, legs clothed with brighter, more rufescent hairs, the apical joints of all the tarsi testaceous, intermediate femora armed beneath towards the base on the anterior side with a strong tooth.

Long. 14 mm.

Although I have only seen this single ♂ I have described it as new as the character of the intermediate femora is so distinct that I feel sure it must be specific.

♂ 1. Biskra, near railway, Kilom. 199, on *Antirrhinum ramosissimum*, 26, ii, 97. (*A. E. E.*)

Ancyla oraniensis, Luc.

♂ 8, ♀ 3. Biskra, corn-lands bordering the Route des Ziban, on *Ammi visnaga*, 18 and 25, v, 93 and 28, v, 97. (*A. E. E.*)

♀ 3. Médéa, on the north slope of Koudia Sma, 8, vii, 93. (*A. E. E.*)
♂ 9, ♀ 1. Biskra, 16 to 23, v. 98. (*F. D. M.*)

MELITURGA PICTIPES, Mor.

♂ 2. Biskra, 26, iv, 94. (*A. E. E.*)
♂ 3, ♀ 1. „ on *Ammi visnaga*, 23 to 28, v, 97. (*A. E. E.*)
♂ 4, ♀ 9. „ 6 to 27, v, 98. (*F. D. M.*)

"The bees sleep at the end of a stick, or dead stem of the spurge, head and thorax downwards, clasping the stem with their legs and mandibles and resting their abdomen on the top of the stem." (*A. E. E.*)

MELECTA LUCTUOSA, Scop.

♀ 3. Algiers, 9, iii to 13, iv, 93. (*A. E. E.*)
♀ 1. Biskra, entering burrows of *Anthophora fulvitarsis*, 20, iii, 94. (*A. E. E.*)
♀ 2. „ 24, iii, 94 and 26, ii, 97. (*A. E. E.*)
♀ 1. Bône, 4, iii, 96. (*A. E. E.*)
♀ 1. Algiers, 9, iii, 93. (*A. E. E.*)
♀ 6. „ 17, iii to 21, iv. (*F. D. M.*)

MELECTA PLURINOTATA.

♀ 7. Algiers, 21 and 22, iv, 98, inquiline of *Anthophora romandii*. (*F. D. M.*)

CROCISA MAJOR, Mor.

♂ 1, ♀ 1. Constantine, on *Inula viscosa*, 4, x, 93. (*A. E. E.*)
♂ 1. Médéa, on *Mentha rotundifolia*, 19, vii, 97. (*A. E. E.*)
♀ 1. La Calle, 15, vii, 96. (*A. E. E.*)
♂ 1. Biskra, on *Ammi*, 24, v, 97. (*A. E. E.*)
♂ 1. „ "At rest during the passing of a big cloud, holding on to the tip of a dead twig with its mandibles only, and having its legs tucked up, its wings incumbent upon the body and its antennæ obliquely porrect and subcontiguous or closely parallel with one another." 17, iv, 97. (*A. E. E.*)

CROCISA RAMOSA, Lep.

♂ 3. Biskra, 1, vi, 93, 24, iv and 13, viii, 97. (*A. E. E.*)

♂ 1. Médéa, on *Eryngium triquetrum*, 28, vi, 93. (*A. E. E.*)
♂ ♀. La Calle, on *Scabiosa rutæifolia*, 18 and 19, vii, 96. (*A. E. E.*)
♂. Bône, 20, viii, 96. (*A. E. E.*)
♀. Le Tarf, 24, vi, 96. (*A. E. E.*)

Crocisa quadridentata, n. sp.

Nigra, antennis crassiusculis, articulis quarto et sequentibus valde transversis Capite, thorace plerumque, abdominis segmentis apicibus fasciis late niveis, medio interruptis, ornatis, segmentum primum et secundum lateribus quoque niveis et primum basi niveum mesonoti scutum postice emarginatum et angulatum, scutellum postice valde emarginatum et in angulos duos piceos productum pedibus niveo-pubescentibus.

♂. Very distinct from any other species of the genus by its more extensive pattern of snowy-white pubescence—the head, thorax except a band across the mesonotum between the tegulæ, and the greater part of the scutellum, clothed with snowy-white hairs, all the segments of the abdomen with a wide apical band of similar hairs narrowly interrupted in the middle, the 1st and 2nd segments with the sides also white-haired, and the first having its base also white, the white pubescence of the 3rd and following segments almost covers the whole of the exposed surface, legs with the apices of the femora and the tibiæ and tarsi externally clothed with white hairs, labrum piceous, antennæ very short and stout, piceous anteriorly, the basal joint clothed with snowy hairs the 3rd joint almost as long as the 4th and 5th together the 4th and following transverse, much wider than long, each joint posteriorly with a shining round impression, in this respect agreeing with *crassicornis*, Mor., mesonotum coarsely punctured, tegulæ piceous, with fine very remote punctures, wings hyaline, their apices darker, nervures dark piceous, the scutum of the mesonotum is posteriorly emarginate, and its angles are produced beyond the base of the scutellum so as to be slightly prominent, the scutellum is very largely punctured, emarginate posteriorly and produced at the sides into two sharp piceous angles, the emargination fringed with white hairs projecting from beneath—abdomen slightly shining, finely punctured, apical segment bidentate, beneath shining the segments each bearing two snowy-white spots, tarsi piceous at the apex, there appears to be no fringe on the apex of the 6th segment.

Long. 9 mm.

♂ 1. Biskra, on *Atractylis serratuloides*, 13, v, 97. (*A. E. E.*)

Apparently closely allied to *crassicornis*, Mor., but there is no mention in the description of that species of the peculiar form of the mesonotum, and the arrangement of the white pattern on its abdomen appears to be quite different, each segment having 2 oval spots widely separated from the margin, whereas in this species they have wide bands.

ANTHOPHORA QUADRIFASCIATA, Vill.

♂ ♀. Common. (*A. E. E.* and *F. D. M.*)
♂. Visiting *Prasium majus* at Algiers in April, *Peganum harmala* at Biskra in April, *Ammi visnaga* at Biskra in May, *Echium italicum* at Constantine in May, *Calamintha* at Tizi Ouzou in June, *Atractylis gummifera* at Bône in August.
♀. „ *Centaurea calcitrapa* at Médéa in July.
♀. „ *Carlina racemosa* at Azazga in September. (*A. E. E.*)

ANTHOPHORA GARRULA, Rossi.

♀ 1. Le Calle, 19, vii, 96. (*A. E. E.*)

ANTHOPHORA WEGENERI, Friese.

♂ 3, ♀ 1. Biskra, near rail, Kilom. 199. Visiting *Limoniastrum guyonianum* (♂ and ♀ *in cop.*) 13, iv, 95. (*A. E. E.*)
♂ 1. Biskra, on *Amberboa lippii*, 11, iv, 95. (*A. E. E.*)
♀. „ 1, vi, 98. (*F. D. M.*)

ANTHOPHORA ALBIGENA, Lep.

♂ ♀. Various localities. (*A. E. E.* and *F. D. M.*)
♂. Visiting *Centaurea* and *Scabiosa*, Médéa, June; *Mentha rotundifolia*, *Eryngium cuspidatum* and *Atractylis gummifera*, at Bône in August. (*A. E. E.*)
♀. „ *Calamintha*, at Tizi Ouzou in June.
„ a *Labiate*, at Médéa in June.
„ *Solanum nigrum*, at Constantine in October. (*A. E. E.*)

Anthophora talaris, Friese.

♂. Biskra, visiting *Peganum harmala*, 12, iv, 95. (*A. E. E.*)

Anthophora nigricornis, Mor.

♀ 1. Biskra, in a garden beside the Route de Tougourt, 1, vi, 93. (*A. E. E.*)

Anthophora magnilabris, Fedts.

♀ 1. La Calle, 8, vii, 96. (*A. E. E.*)

Anthophora fulvodimidiatus, Dours.

♂ 1. Médéa, on *Centaurea calcitrapa*, eyes in life "light sap-green," 21, vii, 93. (*A. E. E.*)
♀ 1. Azazga, on *Carlina racemosa*, 20, viii, 93. (*A. E. E.*)

Anthophora bimaculata, Pz.

♂ 5. Biskra, visiting *Amberboa lippii*, 11 to 13, iv, 95. (*A. E. E.*)
♂ 1. Sidi Ferruch, on *Echium*, 8, v, 93. (*A. E. E.*)
♀ 1. Biskra, on *Ammi visnaga*, 30, v, 95. (*A. E. E.*)
♀ 1. Algiers, 30, v, 93. (*A. E. E.*)
♀ 2. Aine Draham, 21 and 22, vi, 96. (*A. E. E.*)
♂ 1. Biskra, 9, v, 98. (*F. D. M.*)
♀ 1. Constantine, 17, vi, 98. (*F. D. M.*)
♂ ♀. Philippeville, 20, v, 98. (*F. D. M.*)

Anthophora sp. ?

♀. Biskra, on *Ammi visnaga*, 30, v, 97. (*A. E. E.*)

Anthophora albocinerea, n. sp.

Nigra, pilis cinereo-albis dense vestita, clypei apice, labro, mandibulis-que flavis; antennarum articulo tertio quarto quinto-que simul sumptis pœne longiore abdominis apice, ventro, tarsisque infra fusco pilosis.

♀. A short compact species, entirely clothed above with white hairs very slightly tinged with grey, wings hyaline, tegulæ and wing-nervures at the base pale, the latter darker towards the apex of the wing, labrum, mandibles and the apex of the clypeus yellow, the colour produced centrally in a pale line to its base, cheeks entirely black, 2nd joint of the flagellum slightly longer than the 3rd and 4th together, mesonotum where visible through the dense

clothing of hairs very closely and finely punctured, surface of abdomen invisible in fresh specimens, but in a rubbed one seen to be very finely punctured, the apices of the segments narrowly white, 5th segment at the apex with a triangular patch of brown hairs, apical dorsal valve narrow and pointed, clothed at the sides with long brown hairs, segments beneath and tarsi inwardly clothed with brown hairs.

Long, 8. mm.

♀ 1. Biskra, on *Echium humile*, 12, iv, 97. (*A. E. E.*)
♀ 1. „ on the Sandhills, 5, v, 97. (*A. E. E.*)

Closely allied to *pubescens* but the short 2nd joint of the flagellum and the pale labrum and mandibles will easily distinguish it as well as the almost snowy-white pubescence.

ANTHOPHORA FERRUGINEA, Lep., var. *alboferruginea*, Friese.

♂ 1. Constantine, visiting *Phlomis herba-venti*, "eyes light-greyish or ashy-agate," 19, v, 95. (*A. E. E.*)

ANTHOPHORA QUADRICOLOR, Er.

♂ 1. Le Tarf, 24, vi, 96. (*A. E. E.*)
♀ 1. Pointe Pescade near Algiers, on *Echium*, 10, v, 93. (*A. E. E.*)

ANTHOPHORA PUBESCENS, F.

♂ ♀. Algiers, on the ramparts, on *Echium*, 5, iv, 93. (*A. E. E.*)
♂ 3. Biskra, 17, iv, 94. (*A. E. E.*)
♂ 2. „ on *Moricandia arvensis*, 3, ii and 22, iv, 97. (*A. E. E.*)
♀ 1. „ on *Deverra scoparia*, 14, ii, 95. (*A. E. E.*)
♀ 2. „ on *Antirrhinum ramosissimum*, 26, ii, 97. (*A. E. E.*)
♂ 3. Algiers, 14, iii, 98. (*F. D. M.*)
♂ 1. Biskra, 6, v, 98. (*F. D. M.*)

ANTHOPHORA CALCARATA, Lep.

♂ 1. Bône, asleep, hanging on to a stem by its mandibles only, 17, xi, 93. (*A. E. E.*)
♂ 1. Tunis, 20, xii, 93. (*A. E. E.*)

♀ 1. Biskra, on *Zygophyllum cornutum*, 10, ii, 94. (*A. E. E.*)
♀ 1. „ near the Blockhouse above the Barrage, 24, iii, 94. (*A. E. E.*)

Dr. Longstaff took a ♂ on flowers of *Retama retam* at Biskra, 6, iii, 05.

Anthophora fulvitarsis, Brullé.

♂ 1. Biskra, visiting *Lycium afrum*, 6, ii, 94. (*A. E. E.*)
♂ 2. „ visiting *Moricandia arvensis*, 11 to 17, ii, 94. (*A. E. E.*)
♂ 1. Hippone, visiting *Cerinthe aspera*, 17, iii, 96. (*A. E. E.*)
♂ 2. Biskra, 7 and 25, ii, 94. (*A. E. E.*)
♂ 1. Algiers, Colonne Voirol, 4, v, 93. (*A. E. E.*)
♂ 1. Bône, on *Atractylis serratuloides*, 2, v, 96. (*A. E. E.*)
♀ 1. Biskra, burrowing in a bank by the market-garden, 20, iii, 94. (*A. E. E.*)
♂ 2, ♀ 2. Algiers, March and April 1908. (*F. D. M.*)

Dr. Longstaff found it common at Biskra, hovering at flowers of broad-beans, February 1905.

Anthophora crinipes, Sm.

♂ 1. Biskra, Village Négre at *Acanthyllis tragacanthoides*, 19, ii, 97. (*A. E. E.*)

Dr. Longstaff took 4 ♀♀ hovering over flowers of *Acanthyllis tragacanthoides* at Biskra, 16, ii, 05; 2 ♀♀ on the same plant at Hamman es Salahin, 17, ii, 05; and a ♂ and ♀ at flowers of *Asphodel* and *Cynoglossum*, 12, iii, 05.

Anthophora ambigua, Per.

♂ Biskra, stony hills north-west of the town, visiting *Acanthyllis tragacanthoides*. "This species is common in the desert, vigilant and very swift on the wing, hovering and darting off at the least alarm like *Macroglossa stellatarum* or *Plusia gamma*; in the intervals of business they alight to bask on stones, sometimes hovering down, after the manner of small *Syrphidæ* approaching flowers, their hum is nearly of the same pitch as that of an excited hive-bee. I once found one asleep under a stone towards evening." 27, i, 94. (*A. E. E.*)

♀ 1. Biskra, rocky edges beyond the Parc de Beni Mora, on *Acanthyllis tragacanthoides*, 6, ii, 94. (*A. E. E.*)
♀ 2. „ 5, iii, 95 and 4, ii, 97. (*A. E. E.*)
♂ 1. „ 7, i, 97. (*A. E. E.*)

Dr. Longstaff took it on *Vicia* sp. at Biskra, and *Spergula* sp. at El Outaia, February and March 1905.

ANTHOPHORA ROBUSTA, Klug.

♂ 1, ♀ 1. Constantine, visiting *Echium italicum* ♂, 22, v, 95; ♀, 16, vi, 94. (*A. E. E.*)
♀ 2. „ 18, vi, 98. (*F. D. M.*)

ANTHOPHORA HISPANICA, F.

♂ 1. Bône, base of Mount Edough beyond the Orphelinat, visiting *Asphodelus microcarpus*, 26, ii, 96. (*A. E. E.*)
♀ 4. „ visiting *Cerinthe aspera*, 22, iii, 96. (*A. E. E.*)

ANTHOPHORA DISPAR, Lep.

♂ 1. El Biar, near Algiers, 17, ii, 93. (*A. E. E.*)
♂ 3. Bône, 26, ii and 2, iii, 96. "Eyes in life obscurely subolivaceous with the usual deep-seated coarse shady reticulation."
♀ 1. Algiers, on *Echium*, 9, iii, 93. (*A. E. E.*)
♂ 2, ♀ 5. „ 14, iii to i, iv, 98. (*F. D. M.*)

Dr. Longstaff took it on asphodel and cherry-blossoms at Bougie, March 1905.

ANTHOPHORA NIGROCINCTA, Lep.

♂ 1. Biskra, on *Acanthyllis tragacanthoides*, 2, ii, 94. (*A. E. E.*)
♂ 1. Bône, visiting *Asphodelus microcarpus*. "Eyes black opaque." 26, ii, 96. (*A. E. E.*)

ANTHOPHORA VENTILABRIS, Lep.

♂ 1. Biskra, near M'cid, 7, ii, 94. (*A. E. E.*)
♂ 1. „ about walls of "adobe" in village Négre, 13, ii, 94. (*A. E. E.*)
♀ 2. „ on *Moricandia*, 17, ii, 94 and 25, iii, 95. (*A. E. E.*)

Anthophora atriceps, Per.

♂ 1, ♀ 1. Biskra, on *Moricandia arvensis*, 10, ii, 97 and 25, iii, 95. (*A. E. E.*)

♂ 1. „ on *Acanthyllis tragacanthoides*, 12, ii, 97. (*A. E. E.*)

♂ 4. „ on *Antirrhinum ramosissimum*, 26, ii and 21, iii, 97. (*A. E. E.*)

Dr. Longstaff took it on *Spergula* at El Outaia, 1, iii, 05.

Anthophora romandii, Lep.

♂ 4, ♀ 9. Algiers, the host of *Melecta plurinotata*, 14 to 22, iv, 98. (*F. D. M.*)

Anthophora albosignata, Friese.

♂ 1. Biskra, on *Picridium vulgare*, 11, iv, 97. (*A. E. E.*)

Anthophora biciliata, Lep.

♂ 1. Algiers, 6, iv, 93. (*A. E. E.*)

♀ 1. Hussein Dey, near Algiers, on *Echium italicum*, 4, iv, 93. (*A. E. E.*)

♀ 1. Hippône, on *Cerinthe aspera*, 17, iii, 96. (*A. E. E.*)

♂ 4, ♀ 8. Algiers, 14, iii to 25, iv, 98. (*F. D. M.*)

Anthophora retusa, L.

♂ 2. Bône, 11, v, 96. (*A. E. E.*)

var. with all the abdominal segments brown-haired.

Anthophora atroalba, Lep.

♂ ♀. Numerous from Algiers, Hippône, Tunis, Bône. (*A. E. E.* and *F. D. M.*) ♀ visiting *Echium* in April; *Cichorium intybus* and a *Labiate* and *Lavendula stœchas* in May; *Cerinthe aspera* in March. (*A. E. E.*)

Anthophora, sp ?

♀ 1. Biskra, 3, iv, 97. (*A. E. E.*)

Anthophora pilipes, Fab.

♂ ♀. Common from various localities in March, April and May. (*A. E. E.* and *F. D. M.*) Visiting

Cerinthe aspera, *Echium* and *Prasium magus* at Bône and Algiers in March and April; *Stachys circinata* and *Psoralea bituminosa*, at Constantine in May. (*A. E. E.*)

Dr. Longstaff took it at Hamman Meskroutine on flowers of *Cynoglossum cheirifolium*, 12, iii, 05, and at Hamman Rhirha at flowers of *Vinca*, 28, iii, 05.

Bombus læsus, Mor.

♂ ♀. Médéa, on Koudia Sma, alt. about 3,180 ft., on *Eryngium triquetrum* and *Echium*, 3 and 8, vii, 93. (*A. E. E.*)

♀. Médéa, slopes of the Nador up to 3,300 ft., on *Onopordon macracanthum*, 4, vii, 93. (*A. E. E.*)

♂ 2. Lodi, alt. 2,980–3,440 ft., on *Eryngium triquetrum*, it also visits *Centaurea calcitrapa*, 13, vii, 93. (*A. E. E.*)

♂ 4. Aine Draham (Tunisie), alt. 2,700 ft., visiting *Centaurea melitensis*, 20, vii, 96. (*A. E. E.*)

♂ 1. La Calle, 14, vii, 96. (*A. E. E.*)

Bombus raiellus, K.

♂ 1. Aine Draham (Tunisie), alt. 2,700 ft., visiting *Centaurea melitensis*, 20, vii, 96. (*A. E. E.*)

A very unusual variety with the apical segments of the abdomen white.

Bombus hortorum, L.

♂ 2. Médéa, slopes of the Nador, on *Onopordon macracanthum*, 2, vii, 93. (*A. E. E.*)

♂ 4, ♀ 3. La Calle, on *Delphinium peregrinum*, 1 to 15, vii, 96. (*A. E. E.*)

♂ 1. Constantine, 19, vi, 98. (*F. D. M.*)

♀ 1. Algiers, 6, iv, 98. (*F. D. M.*)

Bombus soroensis, F.

♀ 1. Aine Kriar, on *Linaria reticulata*, 22, vi, 96. (*A. E. E.*)

Bombus terrestris (*lucorum*), L.

♂. Constantine, on *Onopordon macracanthum*, 11, vi, 94. (*A. E. E.*)

♀. Médéa, slopes of the Nador up to 3,300 ft., on *Onopordon macracanthum*, 4, vii, 93. (*A. E. E.*)
☿. El Biar near Algiers, 17, ii, 93. (*A. E. E.*)
♀ ☿. Bône, 17, ii, 96 and 2, iii, 96. The common *Bombus* of the district. (*A. E. E.*)
♂ 2. „ Djebel Edough, 11, v, 96. (*A. E. E.*)
♂ 2, ☿ 1. Algiers, 16, iii to 9, iv, 98. (*F. D. M.*)

X. *On the larvæ of* Trictenotoma childreni, Gray, Melittomma insulare, Fairmaire, *and* Dascillus cervinus, Linn. By C. J. Gahan, M.A., F.E.S.

[Read March 18th, 1908.]

Plate VI.

In view of the divergence of the opinions that were at one time held in regard to the systematic position of the *Trictenotomidæ*, a knowledge of the larvæ of this family must prove to be interesting, and I am now fortunately in a position to be able to give some account of a larva which, without doubt, belongs to the family. This larva was received from the late M. Henri Rouyer, by whom it was found in Java "by the side of the débris of pupæ and imagines" of *Trictenotoma childreni*, Gray.

A description is given also in this paper of the larva of *Melittomma*, Murray, a genus of *Lymexylidæ*, and the opportunity has been taken to add a figure of the little-known larva of *Dascillus cervinus*, Linn., which was described by Erichson in 1841.

1. The larva of *Trictenotoma childreni*, Gray.

The larva is 12 centimetres (= 4·7 inches) in length, its general colour pale yellowish-white; the head, which is strongly exserted, is reddish-brown with the front margin and the robust mandibles, black. The head and anterior segments are somewhat flattened and depressed; the legs well developed, and rather widely separated by the broad flat sternal plates. The general appearance would be very suggestive of the larva of *Pytho* or *Pyrochroa* were it not for the difference in form of the terminal abdominal segments. The 9th segment is narrower and somewhat shorter than the 8th, is obtusely rounded behind and carries at the apex two backwardly produced processes which are curved upwards and sharply pointed at the end. The anus is placed transversely on the ventral side of this segment at about one-third of its length from the end.

Head. Porrect, strongly exserted, transverse, rounded at the

sides, 11½ mm. broad, punctate above, reddish-brown with front margin black, clypeus and epistome * not separated, the latter slightly membranous at the front edge, labrum distinct, transverse with obtusely rounded front margin fringed with hairs; antennæ placed laterally on a slight projection of the head, 3-jointed, the 3rd joint very short and narrow, the 2nd much shorter and narrower than the 1st; on the vertex of the head a sutural line, beginning at the occiput, extends a very short distance forwards in the middle and then branches into two curved lines forming a horse-shoe-shaped impression, from the anterior ends of which, transverse lines may be seen running to the sides of the head to end just behind the antennal supports, the form and course taken being very much the same as they are in the larvæ of *Pytho* and *Pyrochroa*; there are no ocelli visible; mandibles large, curved, each with three cusps or teeth at the apex, the left mandible has two teeth on the inner edge; the maxillæ have the usual basal joint or cardo, a rather long and broad stipes which carries a 3-jointed palp, and a rather broad obtuse inner lobe, which near the middle is provided with a horny tooth bifid at the end, the dorsal division of this tooth being slightly longer than the ventral, the lobe is furnished also with some stiff setæ; mentum longer than broad, somewhat trapezoidal in form, labial palpi 3-jointed, ligula narrow; the hypopharyx forms an arch on the dorsal side of the mentum and is produced in front as a flat plate with a slightly emarginate border.

Prothorax widest a little behind the front border, being there 13½ mm. broad, narrowed at the base, where it is only 11 mm. broad; its length equal to that of the head measured from the occiput to the front margin of the epistome: the surface smooth and impunctate, yellowish-white with a few brownish patches; prosternum smooth.

Mesothorax, 11½ mm. broad across the middle, much shorter than the prothorax, and slightly shorter than the metathorax; it carries on the tergum a transverse series of short, small longitudinal carinæ near the front margin, and a set of smaller tubercles forming an oblique patch on each side; the sternum is crossed by a narrow slightly arcuate, pale band or depression in front of which is an area covered with small corneous granules, while behind it there are on each side a few more elongate granules or carinæ.

Metathorax, 11 mm. broad across the middle, a little longer than the mesothorax, but similar to it in structure and in the manner in which the small granules and carinæ are disposed on the tergum and sternum.

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* I use the term *epistome* to denote the piece, often separate, to which the labrum is attached.

Abdomen: The segments are gradually a little wider and longer up to the 4th or 5th, and then narrower and shorter up to the 9th; on the tergites of segments 1st–7th there is a median, triangular, faintly depressed, paler-coloured area, at each side of which is a series of small longitudinal carinæ; there are none of these carinæ or tubercles on the tergite of the 8th segment; but on the tergite of the 9th there are two transverse, curved, carinæ placed a little in front of the apical processes. The sternite of the 1st segment has a straight, narrow pale band or depression across the middle but is without granules or carinæ; the sternites of the 2nd to 8th segments have each a similar, submedian transverse depression, with a granulated area in front and another behind it; the sternite of the 9th segment has a transverse series of granules near its front border, close to the apex there is a curved fold in the integument, and a little in front of this fold, lies the anal, transverse slit. The terminal processes are 3 mm. long, and run almost parallel at a very short distance from one another.

Legs: The coxæ are inserted obliquely a wide distance apart on each of the thoracic segments; they are short and scarcely in the least exserted. The femora are stout, of moderate length, and much thicker towards the apex, the tibiæ are nearly as long as the femora and each is succeeded by a single rather strong claw.

Spiracles: Nine pairs, transversely elliptical in form; the first pair twice as large as the others, placed on the sides of the thorax just below the basal angles of the pronotum, the others placed laterally on the dorsal side of the first eight abdominal segments, the pair on the 1st segment rather close to the front margin, each succeeding pair farther back until at the 4th or 5th they come to be at about the middle of the length of the segment.

In the provisional arrangement of the families of Heteromera made by Ganglbauer in his new system of classification of the Coleoptera, the *Trictenotomidæ* are placed next to the *Tenebrionidæ*, at the end of the series; and most authors when comparing *Trictenotoma* with other Heteromera have professed to find the greatest points of affinity with certain genera of the family *Tenebrionidæ*. But in view of the light thrown upon the subject by the larval characters, these opinions will, I think, have to be altered. The larva of *Trictenotoma* has not only a different general appearance from all known larvæ of *Tenebrionidæ*, but differs also essentially in structure, especially in the wide separation of the legs by the broad sternal plates. On the other hand it has many

characters in common with the larvæ of *Pythidæ*, *Pyrochroidæ* and *Œdemeridæ*, and the chief differences, which are to be found in the form of the 8th and 9th segments of the abdomen, are of only secondary importance and such as might be found to occur between different genera of the same family. The presence of scabrous areas on the tergites and sternites of several segments in *Trictenotoma* is a character wanting in the larvæ of *Pythidæ* and *Pyrochroidæ*, but seems to have a correspondence with the scabrous elevations or tubercles occurring on certain of the segments in the larvæ of *Œdemeridæ*.

On the whole, then, it seems to me that the *Trictenotomidæ*, in a phylogenetic system such as Ganglbauer's, should be placed not at the end, but at, or very near, the beginning of the Heteromerous series. Although the general appearance of the imago seems very unlike that of the *Pyrochroidæ* or *Œdemeridæ* or the other families allied to these, yet it must be remembered that in one very important structural character, namely the open anterior coxal cavities, the *Trictenotomidæ* agree with these families and differ from the *Tenebrionidæ*.

pl. 6, fig 2

2. The larva of *Melittomma insulare*, Fairm.

Melittomma insulare, Fairm., is a species of *Lymexylidæ* that was first described in 1893 ("Bull. Soc. Ent. Fr." 1893, p. cccxxiii). It occurs in the Seychelles Islands, and differs considerably from other species of the genus *Melittomma* in one character which appears to have been overlooked by the original describer; the eyes, instead of being widely separated from one another on the ventral side of the head, are very closely approximated and almost contiguous. Some larvæ of this species that were found living in the stem of the coco-nut palm in the Seychelles, were sent a few years ago to the Director of the Imperial Institute, and by him were presented to the British Museum, with a request for their identification. They were accompanied by examples of the perfect insect. Although no pupæ have been received, there can be no doubt whatever that the larvæ belong to the species indicated. These larvæ are of different sizes, varying in length from about 10 to 30 millim.; and present a very strong family resemblance to the other known larvæ of *Lymexylidæ*, the only noteworthy difference consisting in the

remarkable and peculiar characters of the 9th segment of the abdomen.

The larva is of a pale yellowish-white colour, with the mandibles, the fore margin of the head, and the greater part of the terminal (ninth) abdominal segment blackish-brown. In general structure it agrees very well with the larva of *Lymexylon navale*, the head being rather small, strongly convex or almost rounded, turned downwards, and well exserted from the prothorax; the latter large, considerably raised and obtusely protuberant in front; the legs rather widely separated by the sternal plates, the coxæ exserted and rather long, and the legs in other respects resembling those of *Lymexylon*. It differs considerably however in the form of the 9th segment of the abdomen. This segment is strongly chitinised and has the form of a short cylinder, gradually widened out behind, obliquely truncated at the apex, and there hollowed out in the form of a deep concave depression, the surface of which is strongly chitinised, and marked by a number (18 or 19) of large pits, each with a raised circular rim and with a flat round tubercle in the middle. Twelve of these pits form an outer ring, and five an inner ring within which are placed the remaining one or two pits. The depression is sharply edged all round, and dorsally and laterally the edge is somewhat serrated; while, corresponding with the serrations, the outer surface of the segment is marked near the apical edge with short longitudinal striæ. It is only however in the larger larvæ that the pits in the apical depression have the character just described; in smaller larvæ, they are smaller in size, less approximated to each other, and without the raised rim. At the base of the 9th segment on the ventral side, the 10th or anal segment protrudes to form a sort of pseudopod; the surface of this segment on the parts bordering on the anal opening, are somewhat granulose or shagreened.

In a larva measuring 25 mm. in length, the head has a transverse diameter of $2\frac{1}{2}$ mm., the pronotum is $4\frac{1}{4}$ mm. broad, and 3 mm. long, and the 9th segment of the abdomen is slightly more than 3 mm. in diameter each way. The head is marked with a median sutural line extending forwards from the occiput for some distance and then dividing to be continued as two oblique lines; the epistome is rather long, gradually narrowed to the end, where it gives attachment to a short narrow labrum; the mandibles are short and robust, somewhat triangular in form; the maxillæ are provided with a single obtuse setigerous lobe, and 4-jointed palpi; the labial palpi 3-jointed, the ligula narrow, rounded at the end; antennæ short, 3-jointed. The raised anterior part of the pronotum has a somewhat roughened or shagreened surface, and in large specimens is partly chitinised and of

a reddish-brown colour. In such specimens also the terga of the 7th and 8th abdominal segments have a slightly chitinised, reddish-coloured, transverse band, the surface of which is shagreened. The spiracles, to the number of nine pairs, are transversely elliptical in shape, and situated as in the larva of *Lymexylon.*

3. The larva of *Dascillus cervinus,* L. (Plate VI, fig. 3.)

While this paper was in course of preparation, my colleague Mr. C. O. Waterhouse received for identification, a larva which was reported to be doing injury to grass-lands near Clondalkin in Ireland. This larva was unknown to us at the time, but Mr. Waterhouse soon found that it agreed very well with the description given by Erichson of the larva of *Dascillus cervinus.* Having only a single specimen for examination, and not having yet dissected out the mouth parts, we were led to suggest that the larva might possibly be predaceous in its habits instead of being actually a root-feeder. This suggestion, however, proves to be wrong. Through the kindness of Professor G. H. Carpenter, of Dublin, I have received some additional specimens of the larva, and have thus been enabled to make a more detailed examination of its structure. The large basal molar tooth with which each of the mandibles is furnished affords strong evidence as to the vegetable-feeding habits of the larva; for such teeth are never, so far as I know, met with in carnivorous larvæ, while of common occurrence in those larvæ that are known to feed on wood or vegetable fibres. Professor Carpenter moreover informs me that though he has not actually seen the larvæ eat roots, he has seen them hanging on to roots with their mandibles, and, further, the crops of two that he examined contained finely divided earth with some plant fragments. These facts, however, are mentioned only because they serve to confirm the account which we find has already been given of the habits of the larva in two papers published by Professor Dr. J. E. V. Boas. Unfortunately these papers were not noticed in the "Zoological Record," and I have to thank Dr. Adam Bœving, who has been visiting the British Museum to study the collection of beetle-larvæ there, for bringing them to my knowledge. To Dr. Boas also, my thanks are due for his great courtesy in sending me copies of his papers. The first paper, giving a very complete description and excellent

figures of the larva, appeared in "Tidsskrift for Landbrugets Planteavl," Vol. III, pp. 155–160 (1896), and the second, with description and figure of the pupa, in the same Journal, Vol. X, pp. 147–151 (1903).

The drawings prepared for me by Mr. Horace Knight were already well advanced when I received Dr. Boas' papers. They will serve to supplement in some of the details, the figures and descriptions published by Dr. Boas, and a very brief description of the larva is all that need be given here.

The larva is of a testaceous colour, marked with transverse bands of a somewhat paler tint especially on the ventral side of the abdomen. The coxæ also are of a paler colour ; it is furnished with a number of rather strong stiff hairs arranged somewhat in transverse rows. *Head* relatively very large, the clypeus prolonged anteriorly in the form of a broad flat plate (epistome) which overlaps the base of the mandibles and ends in front in a short downwardly curved piece that seems to represent the labrum ; this is only marked off from the epistome by a slight incision or impression on each side. *Antennæ* 4-jointed, the 4th joint very short and inconspicuous. *Mandibles* robust, pointed at apex, each with two cutting teeth on the inner side and a slender moveably articulated tooth (prostheca), between which and the large basal molar tooth there is a broad depressed space lined with a very pale coloured integument. *Maxillæ* with 3-jointed palpi, and two narrow lobes, the inner lobe bifid at the apex. *Labial palpi* 2-jointed, arising each from a rather distinct palpiger ; *ligula* emarginate in front. *Abdomen* made up of ten segments, of which nine only are visible from above ; the tenth very short, its sternite has an incision in the middle, and its tergite is only just visible beneath the tergite of the 9th, the latter has a short process projecting backwards at each side. *Spiracles*—nine pairs ; the first pair situated, as shown in Fig. 3*a*, on the ventra side of the prothorax, the others, very much smaller in size, placed close to the antero lateral angles on the tergites of the first eight abdominal segments. In structure the spiracles are very interesting ; for as Dr. Boas has already pointed out, though with some expression of uncertainty, they resemble those met with in certain Lamellicorn larvæ. Each has a somewhat crescent-shaped sieve-plate, the concave side of which, into which fits the bulla, is directed towards the head. Whether there is present or not a narrow slit-like aperture between the bulla and the sieve-plate, is a point still to be determined. This can only be ascertained with certainty by making

a section through the spiracle. Viewed in the ordinary way as a transparent object under the microscope, no such aperture could be made out.

The general resemblance that the larva of *Dascillus* bears to a Lamellicorn larva has been remarked upon by Erichson, and gives additional interest to the fact that the spiracles show a great similarity in structure.

A description, with figures, of the larva of *Dascillus davidsoni*, Lec., a North American species, has been published by Mr. J. J. Rivers in the "Proceedings of the California Academy of Sciences," 2nd Ser. Vol. III, pp. 93–96, Pl. II (1891), and an account also is given of its habits. In this larva the head is considerably smaller than in that of *D. cervinus*, and the 9th tergite of the abdomen is more rounded behind and appears to have no apical processes; but the structure of the mouth parts and appendages is essentially the same.

Explanation of Plate VI.

[*See Explanation facing the* Plate.]

XI. *The systematic affinities of the* Phoridæ *and of several* Brachycerous *families in* Diptera. By W. Wesché, F.R.M.S. Communicated by J. E. Collin, F.E.S.

[Read April 1st, 1908.]

Plate VII.

While making some dissections of the mouth and genitalia of *Phora incrassata*, Mg. (the comparatively large species common on our English hedgerows in August and September), I have met with many peculiarities, and have been struck with the position of the family in the systematic lists.

This position has often been debated, the last contribution being from Mr. Charles T. Brues of the Public Museum, Milwaukee, Wis., U.S.A.* He considers that the Phoridæ and Lonchopteridæ are distinctly related, and that the former also have affinities with the Borboridæ and Hippoboscidæ, the wing venation being near that of *Olfersia*, but as a compromise is willing that they should be placed, as Dr. Williston placed them in 1896, in the Cyclorrapha, between the Platypezidæ and the Muscidæ.

Since then Dr. Williston has found some "Nemocerous" characters, "the venation being quite identical with that of *Aspistes* of the Bibionidæ," and considers that the antennæ do not offer "insuperable objections to the location of the family among the Nemocera." He attaches great importance to the fact that in several species the palpi are two-jointed.†

The publication of these views called forth Mr. Brues' essay, which contains a very able statement of the position, an exhaustive review of the literature, but, I regret to say, no convincing argument to support his views.

The late Baron von Osten-Sacken saw the affinities between the Phoridæ and the Lonchopteridæ and included

* The systematic affinities of the Dipterous family Phoridæ.—"Biological Bulletin," vol. xii, No. 6, May 1907.

† Some common errors in the nomenclature of the Dipterous wing.—"Psyche," Dec. 1906.

them both in a sub-family, "Energopoda," with the Asilidæ and Empidæ, placing the group at the end of the Orthorrapha.* Herr. Theo. Becker thinks that they are derived from Nematocerous forms allied to the Mycetophilidæ and notices the structure of the bristles found only in the Phoridæ and Mycetophilidæ.†

Schiner in his "Fauna Austrica" placed them between the Bibionidæ and the Borboridæ, but whether for convenience, or on account of affinity is not clear.

Not one of these authors is sure whether this family belongs to the Orthorrapha or to the Cyclorrapha, and nothing definite seems known about the mechanism of the pupa-case.

The problem being so difficult of solution, Osten-Sacken even going so far as to say that "a real affinity with Phora does not exist anywhere," it may seem presumption in me to attempt to solve it, as I certainly have no pretensions to a comprehensive knowledge of exotic species of Diptera. But I am encouraged to present my views, as I attack from a new position, none of these writers with the possible exception of Becker having made much use of the microscope, while the great majority of the observations from which my conclusions have been arrived at, are founded on the anatomy and microscopic structure, the minute size of these insects mostly requiring a magnification of 250 diameters for a good view of such organs as mouth parts or genitalia.

After an examination and comparison of a number of preparations, and a study of the genitalia of several species of Phoridæ, (I was already familiar with the Muscid forms), I came to the conclusion that they have no real affinities either to the Borboridæ or the Hippoboscidæ, the families that are placed before and after them in Mr. Verrall's list of British Diptera. Further, they are sharply divided from any of the Muscidæ by the absence of the ptilinum, the membrane on the head, which being inflated, is used to push the cover off the pupa-case. The absence of this structure raises a very strong doubt as to whether the Phoridæ have any place in the Cyclorrapha; a doubt that in my mind is a certainty that they have not.

* The position of *Phora* in the system of Diptera, "Ent. Mon. Mag." 2nd ser., vol. xiii, pp. 204, Sep. 1902.

† Die Phoriden. Abh. d. k. k. Zool-botan. Ges. Wien, Bd 1. Heft 1.

It is not only (1) the absence of the pitilinum that separates this family from the Astiadæ, or Borboridæ on one side, and the Hippoboscidæ on the other, but also (2) the venation, (3) the general morphology, particularly of the fore limbs, (4) the articulation of the antennæ, (5) the character of the anterior thoracic spiracles, (6) the structure of the eyes, (7) the peculiarity of the hair structure, (8) many characters of the mouth parts, (9) and the peculiarities of the genitalia.

2. *The venation.* This is so striking and so well known, that it needs no description, and the absence of true transverse veins, brings it far closer to such combinations as are found in the Simulidæ, the Mycetophilidæ, or even in some of the Dolichopodidæ than to the Muscid type.

In *Trineura aterrima*, F., is found a rudimentary vein, consisting of microscopic hairs, following the course of the wing-edge.* This probably shows that the lower thick vein which so abruptly stops, at one time continued to the end of the wing and is the second longitudinal; in comparing the venation with that mentioned above, this ought to be taken into consideration.

Becker has expressed very similar views to those annunciated earlier in this section, in his monograph already referred to. Brues, while holding to his opinion as regards *Olfersia*, admits that the affinity between the venation in *Phora* and *Mycetophila*, as analyzed by Girschner, and which is the source from which Becker's opinion is derived, is almost convincing.

It will thus be seen that the Phorid venation is but of small assistance to the systematist, as in spite of its being so simple, striking and peculiar, it has led to very divergent opinions, it having been claimed as identical with *Aspistes*, and near to *Mycetophila* and *Olfersia!*

3. *Morphology.* The general shape approximates more to that of the Pulicidæ at the other end of the scheme, than to the flattened Pupipara, and the long coxæ and the legs are similar to those of the Mycetophilidæ, the Lonchopteridæ and the Dolichopodidæ.

4. *The antennæ.* The articulation of the third joint of the antennæ on to the second is very characteristic. I say the second joint as Brues has clearly shown in the paper already referred to, that what is usually called the first

* Indicated in Schiner's "Fauna Austrica, Die Fliegen," Plate II, Fig. 4.

joint is a fusion of the first and second. Personally I am inclined to go further, and see more than two joints in the fused part, but for the present I will accept Brues' nomenclature.

The third joint when seen in microscopic section is found to be hollow, very neatly fitting round a bulb at the end of the second joint, which is articulated by a short process descending from the third joint. This is well seen in *Conicera atra*, Mg., *P. ruficornis*, Mg. and indeed in every species I have examined; it appears to be a constant Phorid character.

In the Muscidæ the third joint is slightly hollow at the base, and is penetrated by a cone-shaped process from the second joint which is in contact on all sides, there being no special articulating part. A similar arrangement to that found in the Phoridæ (as far as my observations go) is only found in a few genera in the Dolichopodidæ and in *Lonchoptera flavicauda*, Mg., and in these in a modified form. It will be found in most of the genus *Dolichopus*, and *D. acuticornis*, W., and *Gymnopternus assimilis*, Staeg., show it particularly well. This I consider a strong mark of affinity, which as I shall show later is only one among many.

5. *The thoracic spiracles.* The anterior thoracic spiracles are very constant in character in families, and show little or no variation in genera and species. In *P. incrassata*, *P. concinna*, Mg., *T. aterrima*, *C. atra* and *Gymnophora arcuata*, Mg., they are circular, with chitinous rings or edges, and fringed with simple hairs.

In the Muscidæ and the Hippoboscidæ they are oval and have branched hairs. In the Lonchopteridæ they are oval, but more rounded than in the Muscidæ. In the Dolichopodidæ they resemble the conventional tear, rounded at one end, and gradually tapering to a point. In the Mycetophilidæ and the Leptidæ, the bordering ring is not so well defined and the shape is inclined to the oval. In the Empidæ they are circular, and as in the last four families, simply ciliated, and are very similar to the organs as they are found in the Phoridæ.

6. *The structure of the compound eyes.* In the Nematocera the compound eyes often consist of a chitinous plate, pierced with circular apertures for the lenses. When the eyes are pubescent, the sub-quadrate space between four lenses is occupied by a hair, the socket of which is very

marked, and relatively large; this condition is well seen in some Mycetophilidæ. A somewhat similar structure is found in some Dolichopodidæ, that in *Porphyrops gravipes*, Wlk., being a good example.

In *P. incrassata*, *P. rufipes* and *T. aterrima* and a number of other species this is so far modified that the plate has gone, but the eyes are bordered by chitinous bands, and in each junction of the bands is a socketed hair, very similar if not identical in structure with the hairs found in the Nematocera or Brachycera. The pubescence found on the eyes in the Muscidæ is of a different type, being transparent and weak, and not tapering, just the opposite being found in the Nematocera, where each hair tapers from a comparatively broad base to an exceedingly sharp point, while in the Muscidæ the socket is so minute as often to be scarcely visible, and the lenses are never separated by bands.

7. *The structure of the hair and bristles.* This is peculiar; it is as if each single bristle were made up of a number of fine hairs of various lengths, so that its point and edges appear almost plumose, certainly serrated. The hairs are numerous and strong, and so characteristic in appearance, that it is easy to recognise them as either from a Phorid, or as the apical bristles from the tibiæ of a Mycetophilid. The Mycetophilidæ are the only other family in which this structure is found, and in them only on the tibiæ. It is figured in Becker's monograph already referred to, but will require a magnification of 250 diameters to see clearly on the actual insects. It is so characteristic, that even were other similarities absent, I should consider it a strong mark of relationship.

8. *The mouth parts* are difficult to study owing to smallness of size, but can easily be seen to have but little affinity with those of the Mycetophilidæ, and indeed might be thought to approximate (as they do in some characters) to the Muscid form, yet as I shall show later, can only be homologised by comparison with Nematocerous forms.

Except in *Gymnophora arcuata*, Mg., and here I am not quite certain owing to the imperfection of my preparation, the armature of the species examined is different in the sexes. Not in the manner found in *Tabanus* and *Culex*, where the males are without the mandibles, but in the structure of the labrum and the aculeations or teeth on the paraglossæ; the labrum has in the females of many

species, a frontal barb and lateral sharp processes, while in the male it is, though ample in size, quite unarmed, and the teeth on the paraglossæ are much less developed than those of the female.

The arrangement and number of parts are nearly similar to those in *Bibio*; but the paraglossæ are very large and bear rather widely separated, relatively narrow tracheæ; the cleft between the paired lobes is very deep and unlike *Bibio* has chitinised plates on the interior edges. The mandibles are soldered into the mentum in the median line, and consequently are as in *Dolichopus* as well as *Bibio* on the ventral side, opposed to the condition found in the Muscidæ, where they are invariably on the dorsal side.

The laciniæ of the maxillæ are fused at their points and form the curious triangular aculeation, at the base of the cleft of the paraglossæ characteristic of the Phorid trophi; the cardines are hard to differentiate and may have disappeared. The labrum has in addition to the armature already mentioned, in all the species I have examined, a minute pubescence on the anterior extremities, only to be seen with very high powers. The hypopharynx is strong, and deeply channelled and suggestive of a raptorial habit.

The paraglossæ carry a number of "taste hairs" which occupy two positions, as besides the usual solitary hair at the end of the trachea, there are a number of taste hairs on the edges of the paraglossæ, the ventral surfaces of which have a tendency to chitinise, and have an appearance similar to that found in Nematocerous forms.

This arrangement is peculiar, and a search through my collection has resulted in the finding of a striking similarity in the paraglossæ of *Leptis scolopacea*, L., not only in the position of the taste hairs at the edges, and the chitinous ventral membrane of the paraglossæ, but in the general appearance, in the narrow tracheæ, the tubes much separated from each other, and in the deep cleft, the edges chitinised between the two paraglossæ. The mandibles are also on the ventral side, but here the similarities end, as they are laterally placed and have not fused in the median line. Similar conditions are found on the labium of *Lonchoptera flavicauda*, Mg., together with an armature identical with *L. scolopacea*. The tracheæ are narrow, and spring from paired chitinous plates. The palpi are maxillary and not

labial, as I find atrophying blades of the maxillæ at their bases. In my paper on the mouth parts of the "Nemocera," published in the "Journal of the Royal Microscopical Society" in 1904, I described them as labial as my preparations showed no maxillæ, but my dissections lately made have been more successful, and enable me to say that the lacinia or blade of this insect is 85 μ. or $\frac{1}{300}$ inch long, and I submit that it is as easy to overlook, as it is difficult to dissect, objects of this size.

It will thus be seen that I have found a striking affinity between these three families in the mouth parts, which show that the true place of *Phora* is among the older families of the Brachycera.

In the Phoridæ the palpi in the limited number of species I have examined are labial. This point I very carefully studied, as the palpi being maxillary in *Leptis* and *Lonchoptera* made me suspect that I was wrong in describing them as labial, though perhaps this has little bearing on the matter, if it be remembered that *Bibio* and *Chironomus* differ in this respect.

The palpi are very large, and bear a number of the characteristic Phorid bristles; at their bases are many wrinkles, scarcely annulations, and in one preparation, *Phora concinna*, Mg., they are two-jointed. This is not, however, the only Nematocerous character; in *T. aterrima* the palpi bear the sense organ, found on the second joint in the Mycetophilidæ, Bibionidæ, Simulidæ and Rhyphidæ. This I have thought to be an olfactory organ and I have figured it as such, as it is found on the palpi of *Bibio hortulanus*, L.*

9. *The genitalia* (male). The hypopygium is free and is joined to the abdomen by a membrane; it is furnished with representatives of the usual paired organs. In *P. incrassata* these are hairy bulbs much closer in function and appearance to the cerci of *Periplaneta* than to the usual hooks or forceps of Diptera. In another species, *P. concinna*, Mg., only a single hairy organ with a transverse suture, placed on an asymmetrical platform, is present. In *T. aterrima* two minute hairy bulbs are present. The part that supports these organs and the anus, is in a more dorsal position and is separated by a suture from another lower part. This lower part seems to be formed of the

* Some new sense organs in Diptera. "Jour. Quekett Micr. Club," ser. 2, vol. ix, Plate VII, 1904.

forcipes interiores and *palpi genitalium* and contains the penis. Usually these organs are hidden in the cavity of the hypopygium. In *P. incrassata* are found paired hooks and plates, the latter covered with a minute sculpturing of the chitin identical with that found on parts of the genitalia of *Periplancta*. These hooks and plates surround the penis, which is formed of a hyaline membrane based on a chitinous ring, and with some structure and tubercles on one side. The ejaculatory duct runs up through the chitinous ring, and opens on the side opposite the tubercles. The penis is asymmetrical, and is the simplest and rudest that I know in Diptera. The spinus (unless it has soldered into the back of the penis, and is present as the "structure" alluded to above), and the apodemes, appear to be absent. *P. concinna* has a more elaborate penis, and its base is fused with a lever which probably represents the great apodemes, and sensory structures represent the palpi genitalium and forcipes interiores, but this last portion of the genitalia is difficult to understand and requires more material for study. In *T. aterrima*, though the containing plates of the lower part are easily differentiated as forceps interiores and palpi genitalium, the penis is minute and unsymmetrical, and seems to be a membrane based on a ring as in *P. incrassata, but the ejaculatory sac and apodeme are quite obvious.*

A fourth species, *P. rufipes* ?, has the penis and surrounding parts of another type. The variations generally are much greater than usually found between species, or even genera in the Muscidæ. One cannot but be struck by the extraordinary anomalies in the parts; all these insects have the organs representing the forcipes superiores and forcipes inferiores of a more archaic type than those found in the Mycetophilidæ, together with (in *Trineura*) an ejaculatory apparatus such as is found in the highly specialised Muscidæ.

In *Conicera atra*, Mg., the genitalia are far more symmetrical and appear to approximate to the form that is found in the Lonchopteridæ, and both suggest a relationship to *Dolichopus*.

The genitalia (female). The ovipositor is fairly simple; it is similar in general plan to that found in the Dolichopodidæ, that is to say it is moderately long, protrusile, and with distinct joints, but lacking the chitinous rods found in the Muscidæ. At the distal extremity are

the usual sensory organs. The receptacula seminis are soluble in the process necessary for preparing the insect for high-power microscopic examination. This is never the case in the Muscidæ, with the exception of the Chloropidæ.

In the ovipositor of *P. curvinervis*, Becker, I found a single chitinous rod which appears to be homologous with the apodeme found in the ovipositor of *Simulium reptans*, L., and there are chitinous levers connected with the valves similar to those found in Chironomus, in *Gymnophora arcuata*, Mg., *P. lutea*, Mg., and *P. ruficornis*, Mg.*

On the extremity of the ovipositor of *P. ruficornis* there is a chitinous serrated process, and the abdomens of two females contain larvæ of an unfamiliar type, and I think that this species is viviparous.

Those who have had the patience to follow me through these details, necessary to prove my case, will see that in this family are preserved characters of very archaic type in the peculiar bristle structure, in the cerci, and in the Periplaneta-like structures in the male genitalia while other parts approximate to the Muscid type in the ejaculatory sac and apodeme. In the ovipositor of the female will be found similar anomalies. The ovipositor may be said to be nonexistent in the Nematocera, in the Phoridæ it is well developed, yet in some species carries structures only found in the Simulidæ and Chironomyidæ.

In the trophi, the presence of two jointed palpi in at least two species, the sense organ in *Trineura* and the very general situation of the embedded mandibles on the ventral side are distinctly Nematocerous characters; while the teeth on the paraglossæ are a character only hitherto found in the Muscidæ.

The labrum and hypopharynx are nearer the same parts in the Brachycerous Dolichopodidæ and Empidæ than to homologous structures in any other family, while the paraglossæ and their tracheæ are very similar to those of *Lonchoptera* and *Leptis*.

I have lately found in the heads of some Asilidæ, Empidæ and Dolichopodidæ a chitinous bulb at the base of the hypopharynx, connected with that organ by a tube and having some contrivance resembling a valve. It is obviously homologous with the pharyngeal pump in *Culex*,

* The genitalia of both sexes in Diptera. Wesché, Trans. Linn. Soc. Second series, Zool. vol. ix, p. 363.

but differs in shape, in the valve, and in being more highly chitinised in the outer envelope. The appearance of this organ in *Asilus* and *Dolichopus* is so singular and so similar as to indicate a very near relationship between these three families. The Asilidæ alone among the families of the Brachycera preserve the ciliated hypopharynx, which is so constant a character in the Nematocera.*

Weighing these facts, I must extend Becker's idea of relationship to the Mycetophilidæ; I think that while the Mycetophilidæ, Asilidæ, Empidæ, Dolichopodidæ, Lonchopteridæ, Phoridæ and Leptidæ have had a common ancestry, the Dolichopodidæ and the Phoridæ have each inherited a more than normal tendency to vary, resulting in the curious contradictions in detail that are found in the Phoridæ, and the wide departure of the Dolichopodidæ from the usual type of mouth, the character of the tracheæ in most genera being unique.

It will be noticed in the families enumerated above, that the wing-venation is fairly complex in the larger insects, and simpler in proportion to the size of the others. Taking as an example the venation in *Hippobosca*, which we know by the character of the mouth, has degenerated from a Muscid form, we there see a tendency for the transverse veins to shorten or be lost, and for the veins to leave the lower part of the wing. This is what has also happened in the Phoridæ and Simulidæ, and all three groups appear to have undergone parallel degeneration. As the parasitic habit increased, or size decreased, the wings, being less used or having less weight to bear, became more simple as regards their venation. In the Lonchopteridæ the mouth has closely preserved the characters found in *Leptis*, and except for the remarkable wings and their sexual differences, developed no striking peculiarities, and is probably a family much less liable to vary than *Phora*; so in the wings less simplification is seen though the transverse veins have disappeared. A parallel case appears to exist in the Psychodidæ. The fact that apterous or semi-apterous species exist, belonging to the Phoridæ, Dolichopodidæ, and Hippoboscidæ, bears on my argument, and demonstrates the superior value of the mouth parts as tests of affinity.

* The mouth parts of the Nemocera. W. Wesché, Jour. Roy. Micr. Soc. 1904, pp. 28–47.

This being so the venation, invaluable as a generic character, must be a secondary consideration in grouping the families, for which characters derived from the mouth parts are of greater importance. It follows that drastic alterations are necessary not only in the group under discussion, but even in the Cyclorrapha.

The families of the Brachycerous Orthorrapha are arranged in Mr. G. H. Verrall's list of British Diptera in the order given below in the left column; in the right column as I propose to rearrange it.

Stratiomyidæ	Asilidæ
Tabanidæ	Empidæ
Leptidæ	Dolichopodidæ
Asilidæ	Phoridæ
Bombylidæ	Lonchopteridæ
Therevidæ	Leptidæ
Scenopinidæ	Stratiomyidæ
Cyrtidæ	Tabanidæ
Empidæ	Bombylidæ
Dolichopodidæ	Therevidæ
Lonchopteridæ	Scenopinidæ
	Cyrtidæ

The Asilidæ are placed first on account of the Nematocerous hypopharynx and of the process in the pharynx homologous with the "pharyngeal pump" in the Culicidæ, and therefore also a Nematocerous character.

The Empidæ follow, as they have the same organ but in a modified form. It is well seen in *E. livida*, L. and in many of the minute *Tachydromia*.

The Dolichopodidæ must come next as the possession of a similar process shows a very close connection between these three families, while the arrangement of the mouth as regards the mandibles is also a Nematocerous character.

The Phoridæ follow, not only on account of their Nematocerous characters demanding an early place in the Brachycera, but also from a number of characters which suggest an affinity with the Dolichopodidæ, and in a less degree with the Empidæ. I propose to state these at length at the end of the paper.

The Lonchopteridæ are placed next on account of similarities in the trophi and many other points, following Dr. Williston's and the late Baron von Osten-Sacken's

classification. The Leptidæ come next, as their mouth parts are nearly identical with those of the Lonchopteridæ.

Then come the Stratiomyidæ, Tabanidæ, Bombylidæ, Therevidæ and Scenopinidæ in their usual order, and the Cyrtidæ close the list in the Orthorrapha, occupying a position where their very large tegulæ do not seem at all out of place. It will be seen by this rearrangement that the first, second and third families possess the striking character of the process in the pharynx, the third, fourth and fifth, the equally striking character of the peculiar articulation of the antennæ, while the fourth, fifth, sixth and seventh have chitinous plates on the paraglossæ, and from the second to the seventh family (the Stratiomyidæ) all six have the mandibles embedded on the ventral side.

AFFINITIES BETWEEN THE PHORIDÆ AND THE DOLICHOPODIDÆ.

1. GENERAL MORPHOLOGY.—The thorax and the coxæ, particularly the fore coxæ, are often similar, and the legs are sometimes much alike.

2. ANTENNÆ.—The Dolichopodidæ, Phoridæ, and Lonchopteridæ have a common peculiar articulation of the third joint, discussed more at length in the earlier part of the paper.

3. CHARACTERS IN THE MOUTH PARTS.—(*a*) In *Dolichopus* the mandibles are also embedded on the ventral side, on the median line of the mentum. (*b*) What remains of the maxillæ instead of remaining in the base of the labium as is almost invariably the case, occupy a very anterior position, as far as my observations go—a unique position and a character confined to the two families. (*c*) There are only two other families in Diptera in which the labrum is armed, the Dolichopodidæ and the Empidæ. (*d*) On the labrum of many species of Phoridæ, high powers show a decided pubescence. The hairy nature of the labrum is a peculiar character of the Dolichopodidæ. (*e*) The hypopharynx is strong, deeply channelled, and viewed laterally is more like its homologue in *Dolichopus* than in any other family. (*f*) The palpi are large, and bear a number of bristles, and similar conditions exist in many Dolichopodidæ. (*g*) The taste hairs are similarly arranged, and are larger than in the Muscidæ.

My study of the Phoridæ is based on about a dozen species belonging to four, or if we admit *Apiochæta* of Brues, five genera, and in all the characters of the trophi, with the exception of the palpi, have been very constant, while in the Dolichopodidæ they vary greatly. The short predaceous labium of *Aphrosylus, Dolichopus* or *Medeterus*, lengthens in some *Gymnopternus* (*G. assimilis*, Stæg., for example), and is specialised for flower feeding in *Orthochile*, while *Psilopus wiedemannii*, Fln., has lost the curious characteristic tracheæ of the family. I therefore point out that the affinities pointed out are most readily seen and understood in the genera, *Dolichopus, Aphrosylus* and *Medeterus*.

4. The structure of the compound eyes.—The character of the pubescence on the eyes is similar in some Dolichopodidæ and Phoridæ; it has been fully discussed in section 5.

5. Characters in the male genitalia.—The Dolichopodidæ in the majority of species, have the hypopygium much developed, free, and attached to the abdomen by a membrane; the forcipes interiores and palpi genitalium are outside the cavity of the hypopygium. Similar conditions are only found in the Phoridæ, the two families sharing these characters, though the armature is unlike in detail and general arrangement.

6. Characters in the female genitalia.—In the Dolichopodidæ the ovipositor is similar in type, though with one joint more—all the Phoridæ examined having six segments in the abdomen and three in the ovipositor, while *D. griseipennis*, Stan., has five in the abdomen and four in the ovipositor. The receptacula are also soluble in the preparation of the insect. This is common in the Nematocera, but quite rare in the Brachycera.

7. Predaceous character.—This calls for evidence as it has not before been touched on. (*a*) The structure of the mouth parts in the hypopharynx and labrum suggests a raptorial habit. (*b*) The legs also. (*c*) A preparation of the female of *P. rufipes* shows in the contents of the abdomen, the appearance which I associate with the digested blood or juices of insects. (*d*) I have in my cabinet a small acalyptrate Muscid which I took out of the grasp of *P. concinna*? Both are mounted on the same card, and till I examined them with a lens, I was under the impression that they were "*in copula*"; unfortunately the

head of the victim has been lost, but enough remains to take away the character, or to put it the other way, to establish the character of *P. concinna* as predaceous, but of course I do not commit myself to the statement that every species in the family is predaceous, probably like the Dolichopodidæ they will feed on any animal food. It is but fair to say, that so far nothing similar has been observed by collectors of Phoridæ.

In conclusion I must express my great obligations to Dr. J. H. Wood for the gift of named specimens, and to Mr. E. E. Austen for kind criticism and information on the literature of this subject.

Explanation of Plate VII.

[*See Explanation facing the* Plate.]

XII. *Notes on the value of the genitalia of insects as guides in Phylogeny.* By W. Wesché, F.R.M.S. Communicated by J. E. Collin, F.E.S.

[Read June 3rd, 1908.]

The study of organs such as genitalia or mouth parts through a series of Orders has yielded much matter of interest, and the value of the mouth in classification has been fully recognised. A further investigation through the families of an Order is still more interesting, but it is a study beset with difficulties and pitfalls on every side. The material is so vast that the anatomist must pick his species, and suitable material is often not sufficiently abundant, especially in specialised forms. Conclusions derived from one form are obviously dangerous enough, but conclusions derived from the study of a number may be absolutely wrong when applied to a particular species. I have in my mind a typical case, where a very careful worker who had specialised on a particular family, denied the presence of two-jointed palpi in that family. As a matter of fact the vast majority of species are one-jointed, but at least three, of which one is a very common species in England, are two-jointed. This is the kind of danger which besets the worker in insect anatomy, and should be allowed for in estimating the value of his work. So if I now attempt some generalisations, I do so conscious of the difficulties of my endeavour.

Since the year 1900 I have made studies of the mouth parts and the genitalia of a number of species, and I have paid special attention to those contained in the Order Diptera.

A more general study of various families, selecting in each the most aberrant as well as the most widely distributed, or the most common species, shows that certain families are more conservative in type than others. But this conservatism may only apply to the mouth, while the genitalia are more variable, as is the case in the Syrphidæ; while in the huge group of the calyptrate Muscidæ, as long as the mouth remains unspecialised (a part ordinarily

most conservative in form), the male genitalia follow closely a common type.

Further, comparing family with family, one realises that cases of parallel development or degeneration occur. Many instances are found in the trophi; the mouth parts in *Conops*, certain Cyrtidæ, *Proscna* and *Glossina* are much alike in appearance, and the proboscis is formed in all cases from a modification of the under plate (mentum), and only differs in detail, yet this similarity is clearly no indication of affinity.

In the genitalia, the ovipositor may be especially modified and hardened into a boring apparatus as in the Phytomyzidæ, but a somewhat similar chitinising of the extremity in the viviparous *Phora ruficornis*, Mg., is no sign of relationship.

The degeneration of the wings is another similar character, and I think we must admit a tendency in the smaller forms in families, towards a simplification of the venation, and this must go into the same category. It is obvious that these parallel developments or degenerations must be recognised and ignored, when taking into consideration any Phylogenetic characters.

The lines of modification in the male genitalia all tend to two ends, an effective fertilisation of the female and an effective isolation of the species; so that these may come under the head of parallel developments, but as the second cause must result in very varied morphology, it can be excepted from the above generalisation. Indeed in these variations in the inner parts (the penis and its appendages) are to be found the more valuable Phylogenetic characters; the outer claspers (the forcipes superiores and inferiores of Dziedzicki) are sometimes of generic, but oftener only of specific value, as may be seen in *Anopheles* and *Tanypus*.

In families which may be considered some of the oldest in the Nematocera, three types of penis are found: (1) a long styliform tube as in *Tipula*; (2) a prominent chitinous process with lateral processes, as in *Ptychoptera*; (3) and a low membranous process supported by lateral chitinous hooks or levers, as in the Australian genus *Gynoplistia* and in *Culex*.

Of these three forms the most striking is that of *Tipula*, and I think it can be clearly shown by methods of comparative anatomy, that modifications can be traced

through a number of families in the Nematocera and the Brachycera, and are in these cases useful Phylogenetic characters. It can be recognised in *Scatopse*, more particularly owing to the characteristic structure of the ejaculatory sac. *Pachyrrhina* has only specific differences from *Tipula*. In the Stratiomid Sarginæ and Berinæ great changes have taken place resulting in a shortening and thickening of the style, and a simplification of the ejaculatory apparatus; but the type remains the same, a chitinised process acting as a guide to a chitinised tube, which expands into an ejaculatory apparatus. Quite close to this are the forms of penis generally found in the Asilidæ and Dolichopodidæ, while in some species of *Empis* they are very near *Tipula* in the flagellum, and resemble the Stratiomyidæ in the ejaculatory sac. The Pipunculid *Chalarus spurius*, Fln., also has a styliform penis, but differs in the ejaculatory sac which is membranous.

The extraordinary contradictions in characters, structures which are usually only found in the older families persisting side by side with late specialisations, show us that reliance cannot be placed on any single character as a test of Phylogeny. Whether that character be venation, mouth part, genitalia, shape or microscopic structure, unless supported by another character, it is apt to mislead.

This is demonstrable by comparison of the mouth parts of *Glossina* and *Stomoxys*; both are, as is well known, specialised for blood-sucking, and are somewhat alike in appearance and arrangement of the parts. The impression derived from a comparison of the male genitalia is very different; *Stomoxys* * is close to the normal Muscid type, while in *Glossina* a remote and curious modification of that type is established, which appears to be a generic character, as I have found it common to the six species I have examined. The venation also shows that while *Stomoxys* approximates to the Cyrtoneurinæ, *Glossina* is closer to the later Muscid type, as it is found in *Calliphora*, or as Mr. E. E. Austen points out to me, is nearly identical with the Œstrid *Hypoderma*.

* The late F. Tullock, in his paper "On the internal anatomy of Stomoxys," Proc. Roy. Soc., vol. 77 B, 1906, p. 525, describes the penis as of the "same type as Glossina." In the sense that both are Muscid in type, I am with him—but further I cannot follow, as the comparison suggests to me an extremely remote degree of relationship, or rather, a great divergence.

From this it can be seen that the presumption of close relationship suggested by the mouth is contradicted by the character of the male genitalia, and the venation only proves a family relationship. But when the extraordinary changes in the ovaries of the female of *G. palpalis*, Des., shown in Prof. E. A. Minchin's paper,* *Stomoxys* remaining normal, are taken into consideration, together with many other points of structure external and internal, it is clear that *Glossina* and *Stomoxys* are far removed from each other.

A comparison of the Muscid species bearing specialised trophi, *Drymia*, *Stomoxys*, *Hæmatobia*, *Lyperosa*, *Prosena*, *Siphona*, *Glossina* and *Madyza* (the details of the argument are too long to quote here), has led me to the conclusion that these specialised mouths, like those of the genera already quoted, are cases of parallel development.

The genital affinities between *Tipula*, *Scatopse*, the Stratiomyid genera, *Asilus*, *Dolichopus* and the Empidæ are supported by a similarity which is also a peculiarity, in the anatomy of the mouth. In families in which the mandibles are aborted, they are embedded in the labium.

(1) In the Tipulidæ it can be demonstrated that they are in the ventral side, as the lever on the dorsal side sends out processes to which the palpi are attached, which shows that they are the fused cardines and stipites of the maxillæ.

(2) In *Dolichopus* there is a marked thickening of the mentum on the median line and a structure showing the presence of atrophied or aborted organs. In the related *Aphrosylus raptor*, Hal., the mentum is simple and without this structure, but two chitinous blades can be dissected out of the muscles underneath it.

(3) In the Empidæ, Stratiomyidæ and *Scatopse* this character of a thickening of the chitin of the mentum on the median line is very marked.

(4) In the Asilidæ the mandibles are present, so the character fails, but the presence in the head of a structure, homologous with the pharyngeal pump in *Culex* and *Tipula*, connects it with the Empidæ and Dolichopodidæ, and so establishes the value of the genitalia character in all these instances.

The second type of penis, that found in *Ptychoptera*

* Report on the anatomy of the Tsetse-fly (*Glossina palpalis*) Proc. Roy. Soc., vol. 76 B, 1905.

seems to foreshadow the Muscid type, in the symmetry and regularity of the lateral processes, while the forms found in *Culex* and *Gynoplista* do not seem to be represented in later families.

The Tabanidæ and Leptidæ are closely allied on the venation, but far apart on the characters of the mouth parts, the details of structure being without suggestion of affinity, the mandibles having disappeared, and a much simpler armature being usually found in the latter family. The genitalia in *T. bromius*, L., ♂, are very complicated in the details of the ejaculatory apparatus, yet these complications are closely reproduced in *Leptis conspicua*, Mg., and with less difference than is often found between the species of the same genus.

Another point that suggests affinity is similarity of arrangement. In a number of families in Diptera, the hypopygium is turned in under the abdomen; but in only one, the Dolichopodidæ, and that only in certain genera, are the appendages that surround the penis displayed and disposed outside the cavity. An examination of the armature in the Phoridæ shows a prominent hypopygium, but the microscope shows that it consists of two portions, a segment supporting the anus and the representatives of the larger hooks (Dr. J. H. Wood's "anal protuberance"), and a second segment often with aculeations, containing the penis. This second segment, judging from numerous points of comparative anatomy, homologises with the appendages that surround the penis (theca), which are, as in *Dolichopus*, displayed outside the hypopygium.

This similarity of arrangement exists without the least trace of similarity of detail (unless it be in Conicera) or of structure suggesting affinity; but as there are striking points in the antennæ, the mouth and general structure that show an affinity between the Phoridæ and the Dolichopodidæ, the similarity of arrangement appears, especially as it is so singular, to be of Phylogenetic value.* A remarkable development of the genitalia, both in the male and the female, in some of the Acalyptrate Muscidæ has been undervalued by systematists. It is true that in Osten-Sacken's list of 1878 and Verrall's British list of

* In some rare cases asymmetrical forms of the inner parts are found, as in *Periplaneta*, and I have also found such a state in the "second" segment (the corresponding part) and its contents in some Phoridæ.

1901 the Ortalidæ, Trypetidæ and Lonchæidæ follow each other, but the horny telescopic ovipositor of the females and the remarkable development of the Muscid form of the male genitalia show that the differences between the three sections are only generic, and that they form one natural family. This opinion is strengthened by the character of the trophi, which is fairly constant through the group. In the labiums of the Ortalids *Scoptera vibrans*, L., and *Pteropætria nigrina*, Mg., and the Trypetid *Acidia lychnidis*, F., are similar chitinous paired processes, which are peculiar and striking. This shows a very close relationship, and proves that a classification which places the two first insects in one family and the third in another, cannot be a natural one.

The ovipositor. Three types are met with in Diptera, (A) the telescopic or protrusile, (B) the non-telescopic, and (E) the styliform. The telescopic may be subdivided into (C) those with a framework of chitinous rods and (D) those without. The B type is undoubtedly the oldest and seems nearly universal in the Nematocera. A and B are both represented in the Muscidæ, but B is far oftener met with in the Acalyptrates. C seems confined to the Muscidæ, but examples of D may be met with in a few Syrphidæ, and in the Dolichopodiæ, Phoridæ and Chloropodæ. In some Phoridæ the ovipositor has a lever to extend it, somewhat similar in shape to a process found in the non-telescopic ovipositor of the Simulidæ, and whose homologue appears to exist in a different form in the Chironomyidæ.

E. The styliform is found in the peculiar organ of the Pipunculidæ, but there are one or two aberrant forms such as *Phorocera scrriventris*, Rnd., which I have come across in the Muscidæ, which might come under this head, but are really parallel developments. The types may be arranged in a Phylogenetic scheme placed in the order of hypothetical evolution, beginning with the oldest.

B. *Non-telescopic.*
E. *Non-telescopic* chitinised forms as in *Pipunculus.*
D. *Telescopic without rods* other than a single lever.
C (1). *Telescopic with many rods.**

* There are contained in the abdomen, parts of the female genitalia that strangely enough have characters. These are the receptacula seminis ; they vary in number from one to four, have sculpturing on the cases, and may have characteristic shapes in certain genera, as in *Palloptera*, but their differences are mostly specific.

C (²). Telescopic and with chitinised joints as in *Ortalidæ*.

Conclusion. I have already alluded to the difficulty of estimating a position in a systematic list brought about by the contradictions of characters, an archaic being contradicted by what we might call a late specialisation. But search will usually reveal an overwhelming balance on one side or the other, and it is usually the archaic character that stands. A comparison of two well-known flies will illustrate my point. The mouth parts and the male genitalia of *Calliphora erythrocephala*, Mg., and *Scatophaga stercoraria*, L., are absolutely homologous part for part, and quite close together in all respects. But *C. erythrocephala* has a telescopic ovipositor extended by rods, while in *S. stercoraria* it is non-telescopic. *Scatophaga* is undoubtedly the older type, and the wide space between the eyes of the male (Williston's *dichoptic*), the small calyptra, and the open first posterior cell of the wing confirm the older type of ovipositor.

To take a more difficult case, the Phorid *Trineura aterrima*, F., has an ejaculatory apparatus in the male genitalia, usually only found in the Muscidæ. Against this, the species has dichoptic eyes, D type of ovipositor, no ptilinum, and mouth parts which have characters in the labium and mentum only found in the Brachycera and Nematocera, and a sense organ on the palpi practically exactly similar to that found in the Nematocerous Dilophus. The evidence is overwhelming that Trineura has no place, even in the older families of the Muscidæ. We get collateral evidence when we find that other Phorids are without the ejaculatory sac and apodeme, and that the Pipunculid *Chalarus spurius*, Fln., together with a styliform penis, has a similar ejaculatory apparatus.

1. From these observations it may be assumed that those characters both of the male and the female genitalia, which are found in the Nematocera, when they can be recognised in other suborders, are the more reliable as guides in Phylogeny.

2. That a similarity of arrangement, when very exceptional and aberrant from the usual type, may also be relied on.

3. It can also be assumed that though genitalia cannot invariably be relied on to solve problems in Phylogeny, the evidence they afford is valuable and must be carefully

weighed, and they will always in the male afford specific characters.

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Supplementary Note. Since writing the above paper I have, with the aid of Dr. J. H. Wood, who has kindly supplied the material and notes on the external characters, made preparations and dissections of some Phoridæ which are included in Brues' genus of *Apiochæta*. The male genitalia throughout show a striking generic character in the presence of pads of chitinous cilia, supported by asymmetrical rods and rings, forming an organ of extremely complicated structure, whose minute size makes it difficult to study or understand, but I can in several species see the ejaculatory duct opening into the bases of the structures supporting the chitinous cilia. This arrangement is quite distinct from the apparatus found in such *Phora* as *incrassata*, Mg., or *curvinervis*, Beck., and appears to characterise the group and is good evidence in favour of the natural character of Brues' genus. It is interesting

that in the Chironomid *Tanypus monilis*, L., I have also met with these pads of chitinous cilia in the genitalia, and also have been unable to find an external opening of the ejaculatory duct, but in this insect, unlike the Phoridæ all the parts are symmetrical; the structure is so peculiar that it may be one more of the numerous links connecting the Phoridæ with the Nematocera.

XIII. Erebia lefebvrei *and* Lycæna pyrenaica.

By T. A. Chapman, M.D., F.Z.S.

[Read March 4th, 1908.]

Plates VIII—XIII.

In spite of demonstration to the contrary, we find these two species sunk as varieties in Staudinger's 1901 Catalogue.

After making full allowance for Staudinger's prejudice against allowing any French form to be a good species, as seen in several other instances besides these, his unquestionable eminence makes it necessary to prove by every available means that these species are not mere varieties.

As regards *lefebvrei* I demonstrated abundantly in our Transactions, 1898, p. 225, by the structure of the ♂ ancillary appendages, that *lefebvrei* and *melas* were distinct species.

Unfortunately such characters do not appeal to a very large proportion of entomologists, chiefly because they know nothing about them. In consequence, they entirely misinterpret such facts as Dr. K. Jordan especially has illustrated, viz. that these appendages are as variable as any other characters, and often differ in a regular way in different races of the same species. From such circumstances they hasten to the conclusion that these structures give no certain indication of specific differences, and in short, which doubtless they find very comforting, that what they don't know is not worth knowing. Yet, because these structures present such variations, to assume that their indications are untrustworthy, is of about the same order of logic, as to assume that *Colias edusa* and *Colias hyale* are one species, because *C. edusa* var. *helice* is of much the same colour as *C. hyale*.

It happens further that though I fell into no error as to the relations of *lefebvrei* to *melas*, nor indeed as to those of *melas* to *nerine*, I made the serious error of assuming that *nerine* and not *melas* was the prior name. This error as to nomenclature, no doubt discounted the value of my

evidence as to structural details, in the eyes of those to whom correctness of nomenclature is everything. Not that I am a heretic as to the value of correct nomenclature, and I am certainly strongly opposed to those who err therein wilfully, but I do plead that in studying structure, it is a grievous drawback to have to spend time in nomenclatorial research.

In visiting the Pyrenees last (1907) summer, one of my objects was to study on the spot these two species, and with regard to *E. lefebvrei* to determine some points, quite apart from the structure of the appendages, that would appeal to the ordinary systematist as proving it to be a species distinct from *E. melas*.

I obtained a very fair series of *E. lefebvrei* at Gavarnie, and had the pleasure of exhibiting them to the Society (Feb. 5, 1908). Of *E. melas*, I have a fair series from various sources, chiefly from Staudinger and from Mr. A. H. Jones.

At Gavarnie *E. lefebvrei* occurs apparently in all suitable localities. These are always more or less steep stony slopes, so that it is not altogether erroneous to compare its habits in this respect with those of *E. glacialis*. The range of *E. glacialis* is, however, some 1,000 feet higher than that of *E. lefebvrei*, and its habitats are even more stony and bare than those of the latter. Both, however, occur amongst rough stones where it is practically impossible to follow them and where it seems a problem where the larvæ can find food. Both, if driven off into grassy ground, work back at once to the stony slopes. But both may also be met with on steep slaty screes, on which locomotion is fairly practicable. The lowest level at which I met with the insect at Gavarnie was on the floor of the Cirque, at about 5,500 feet. I met with it in various other directions, but it was most abundant and most easily captured on the ridge between the two paths to the Port d'Espagne, but more especially on its north slope looking down into the Val de Holle, at about 7,500 feet. It was also seen freely at the Port d'Espagne itself, rather on the Spanish side, on tolerably level ground (for *lefebvrei*). The females are much less numerous than the males, not probably actually, but from the collector's point of view, and like those of *glacialis*, not unfrequently occur, singly or paired, towards the grassy lower margin of the bare slopes where the males disport themselves.

E. melas, from all I can learn about it, much more resembles *nerine* in its habitats than it does *lefebvrei*. It is found (even in the South and East of Europe) below 4,000 feet, and does not go much above that elevation. At Herculesbad it occurs on the slopes of the Domogled, which is only some 3,600 feet high. This is like *nerine*, which occurs when I have taken it at Cortina and on the way up to the Mendel Pass a good way below and not much above 4,000 feet. Its habitat at Mendel is below that of *E. curyale*, a by no means high level form.

In regard to the structure of the clasps all three belong to the group that contains *pronoe*, and may be called the *pronoe* group, *pronoe* being the most abundant and widely distributed, possibly but not necessarily, the most ancestral of the group. *Scipio* is the other member of the central portion of the group. *Neoridas* and *zapateri* are also very close if not actually within the group. Others are less close. The clasp in this group is characterised by a robust body and a long and comparatively slender neck. There is a dorsal prominence where the body joins the neck, and this usually carries some spines. They are absent in *scipio* and very often in *nerine*.

Lefebvrei has these spines at the angle well-pronounced, and has others more basal on the body.

Nerine and *melas* are identical, usually there is one spine at the junction of the body and neck, in *nerine* sometimes none; I have a specimen of each species with three spines here. In neither of them do any spines occur back on the body, but not unfrequently there is an odd spine or two on the neck, usually looking as if it were one of the terminal spines retreated on to the neck, sometimes it is nearer the base. In *lefebvrei* the terminal spines are a group confined to the end of the clasps, in *nerine* and *melas* they are often very much the same, but also often spread round and tending to invade the neck. I have not seen this in *lefebvrei*.

One result of these differences is a marked contrast between the clasps of *lefebvrei* and *melas* (with *nerine*) when seen in profile at the proper angle.

Lefebvrei appears to have the body of the same or nearly the same thickness to the angle, and then with a rapid sweep, often incurved, the margin descends to the comparatively slender neck. In *melas* the body gradually narrows to the angle and proceeds onwards in the neck

with no very marked transition, even when a spine or two is present on the angle.

When we come to the ordinary imaginal characters, we find *nerine* has the usual *Erebia* markings on both surfaces, whereas *lefebvrei* and *melas* are very wanting in the red-brown of the upper surface and the ♂♂ have usually the hind-wings beneath pure black, with no very decided markings, except the ocelli. This, in fact, is the ground, and the only one that I know of for uniting *melas* and *lefebvrei*. Yet this is a feature in which a great many species vary so much. As every one knows, a form of *glacialis* was for some time called *melas*, var. *nicholli*, and really it was extremely difficult to say in what it differed from *melas*; it took this form in its well-known habitat near Campiglio. It agreed with *glacialis* in a habitat of about 8,000 feet. It differed from it, in any other places where I have taken *glacialis*, now a good many, in all the specimens being of fairly uniform type, viz. closely resembling *melas*; in other localities, darker or lighter forms, or others occur together in varying proportions. There is always some range of variation. M. Calberla, however, showed that the male appendages proved *nicholli* without a shadow of doubt to be *glacialis*. This is perhaps the most marked and celebrated case of a *melas* form presented by an *Erebia* that is often of fairly ordinary *Erebia* facies. But *pronoe*, *manto* and others have well-known dark forms.

When we come to the few wing-markings these species present, that have a real value for specific distinction, we find *lefebvrei* by itself and *nerine* and *melas* in agreement.

All have the pair of ocelli on the fore-wings between veins 4 and 6. All have in addition, but rarely, the apical spot between 6 and 7. When this occurs we find it in *lefebvrei* in a line with the other two, as in *cvias*. But in *nerine* and *melas*, it is nearer the margin as in *stygne*, not quite so far out as in *stygne* but nearly so. When I wanted to examine as many specimens as possible, as to this and other characters, I looked over the series in the British Museum at South Kensington, and the first *lefebvrei* that caught my eye had this apical spot very far out; this did not accord with my other observations, but a second glance showed this specimen to be one of *stygne*, a species that often flies with *lefebvrei*. This specimen had, up till the date of my examination, escaped detection as an intruder. The circumstance illustrates how difficult it

sometimes is to separate some species of *Erebia* from each other. Some specimens of *stygne* that I took flying with *lefebvrei* required rather close scrutiny to detect; I was always able, however, to say which species a doubtful specimen belonged to, before examining the appendages, but it is extremely useful to have so certain a method to fall back upon for confirmation, the appendages of *lefebvrei* and *stygne* being so abundantly different.

The ocelli of the fore-wing present another very decisive character. They are much nearer the margin in *lefebvrei* than in the others. Comparing specimens much alike for size and other things, the 2nd ocellus is 2·5 mm. from the cilia in *lefebvrei*, 4·0 mm. in *melas*, and the upper of the two apical ocelli is in *melas*, as compared with *lefebvrei*, further from the margin to a greater proportional distance than the second. The difference in alignment when the third apical spot is present already referred to, might be perhaps more correctly described as due to a difference in position of the usual first spot rather than of the accessory one. (Pl. VIII.)

The fascia of the under-side, especially of the under-wing, presents features that are perhaps more to be depended on in distinguishing the species of *Erebia* from each other, than any other. (Pl. IX.)

The three forms we are considering, belonging as they do to the same group of *Erebiæ*, have a general similarity on the under-sides. The females, as usual, presenting the markings characteristic of the species much more evidently than the males. In *lefebvrei*, indeed, one might say the under-side of the hind-wing of the male is uniformly deep black (ocelli apart), but in a few specimens, that are very perfect indeed, a slightly different tone of the black, or one might almost say a mere difference in the polish of the surface, shows the markings in the characteristic line, that is quite plain in the females. In *melas* the males are very black beneath, but the black is not so deep and intense as in *lefebvrei*, and it has to be a decidedly bad specimen in which the characteristic marking is invisible. (Pl. X.)

In many *Erebiæ* there is, underneath the hind-wing, a pale transverse band in which the ocelli are placed; this band is well developed in *curyale* and *æthiops*. In our species it is also quite distinct.

The darker margin outside the band is difficult to see

in *lefebvrei* ♂, but in *melas* ♂ and *nerine* ♂ it is a more or less continuous narrow band, its basal margin either quite straight or more or less indented at the veins. In the ♀♀ of all it is more or less broken into lunules separated by the pale band stretching along the veins either almost or quite to the cilia.

The basal margin of the pale band is however by no means the same. It is so nearly the same in the two sexes that we may treat of them together. In *lefebvrei*, this margin begins on the costa at much the same place as in the others, and crosses the wing in the same curves as in *melas* and *nerine*, but much less pronounced, so that though one could not call it straight, it is almost so in comparison with their more marked curves and indentations. When it reaches the third (there are usually 3, there may be 2, 1 or none, I have no specimen with 4 on the under-side) ocellus between veins 2 and 3 it is very close to it, about the width of the (average) ocellus distant from it, and proceeds down and reaches the margin in the next interspace (between veins 1 and 2). In *nerine* and *melas* this line is more curved, in *nerine* almost always markedly so, in *melas* only a few specimens have it so curved as in *nerine*, but all much more so than in *lefebvrei*. By curved I mean especially the rounded projections between veins 3 and 4, and between 4 and 6, with the marked indentation on vein 4. When opposite the last ocellus (between veins 2 and 3) it is a long way from it, it proceeds very well-defined across the next interspace and reaches the hind margin to the inner-side of vein 1. This difference amounts practically to this transverse line at its inner extremity reaching the margin of the wing on the hind margin in *lefebvrei*, on the inner margin in *melas* and *nerine*.

It may be further noted that as in the front-wing, so in the hind one, the third ocellus especially is much nearer the hind margin in *lefebvrei* than in *melas* (or *nerine*), and is nearer also in comparison with the 2 (usually 2) others. I was, at one time, convinced that there was a difference in the form of the wings in the two species, *lefebvrei* and *melas*.

I have been quite unable, however, to substantiate this opinion by wing measurements. The strong impression one has, however, to this effect, is not hallucination, it is probably the result of the different positions of the ocelli

in the two species. If the ocelli occupy, always (say in the genus *Erebia*), precisely the same place, morphologically, on the wing, as seems very probably the case, then the apparently changed positions must be due to a variation in the relative proportions of the wing areas internal and external to the ocelli, a very important change of wing form, although the actual outline may be unaltered.

There is another difference between *lefebvrei* on the one hand and *melas* and *nerine* on the other, in the colouring of the antennæ. In some genera a difference in the colouring of the antennæ forms a very good specific character. In *Erebia* I think this is not so and has little more value than the colour of the wings. Still, such as it is, it is very decided in the present case. In *melas* a glance at a long series gives the impression that the under-side of the antenna is white, and similarly in the case of *lefebvrei*, that it is dark, whilst in *nerine* the same area looks pale, not so white as in *melas*, but the difference is more from contrast with the paler insect than in actual colour of the antennæ. In both the colour is creamy, tending to white in *melas*, to terra-cotta in *nerine*.

A closer examination shows the tinting to be much alike in *nerine* and *melas* and to consist of a broad stripe of nearly three-fourths the circumference of the shaft of the antenna, narrower on the club and almost reaching the tip, it is paler on the club. The breadth of the pale portion is such that it is almost always visible from above; in an ordinary set specimen it is obvious without moving the insect.

In *lefebvrei* the antennæ from above look uniformly black, the pale band is very narrow (or wanting in some) and of a darker colour, and is interrupted at the neck of the club, a feature that exists in some degree in *melas*. In short the pale side in *melas* obtrudes itself, in *lefebvrei* requires looking for, hence the conclusion derived from a first glance at a series.

These differences are found not only in selected examples, but in all specimens examined. I have examined probably nearly 200 specimens of each of the three forms, nearly half this number in my own boxes and Mr. Tutt's. They seem abundantly adequate to prove *lefebvrei* and *melas* to be distinct from each other, even if the evidence from the appendages did not exist. They also prove that *melas*

and *nerine* are races that are very closely related. My own opinion still is, that they are local forms of one species, but there is no difficulty in any one believing they are distinct; it is more a question of the definition of "race" and "species" than of the precise amount by which the two forms differ.

The plates are from enlarged photographs by Mr. A. E. Tonge, and will enable all the points noted to be easily seen, except the colour of the antennæ, which they do not illustrate.

Lycæna pyrenaica is a very interesting species, being very close to *L. orbitulus*, yet abundantly distinct. It is especially to be observed that it is not the Pyrenæan representative of *L. orbitulus*, that species occurring in the same region.

Pyrenaica seems to be less variable than *orbitulus*. I found odd specimens at various places near Gavarnie, places a very long way from and very different to that in which I appeared to recognise one of its headquarters. This was on a steep slope at about 5,500 feet, where a limestone of almost chalky whiteness formed the greater part of the surface, sometimes in rocky outcrops, sometimes in partially overgrown screes, not easy to get about on, sometimes quite impassable.

One recognised that the marked paleness of *pyrenaica* here corresponded with the colour of the rocks, and when the males settled, it was very difficult to see them on the white rubble, unless they had been actually seen to alight. One concluded that this cryptic coloration afforded them valuable protection, and that their rarity elsewhere was probably due to the want of this and not to any absence of food-plant or climatic conditions. I gather that M. Pierret (Ann. Soc. Ent. France, 1848, p. 399) found the insect at precisely the same place where I took it.

Any doubt as to *pyrenaica* being a variety of *orbitulus* is set at rest by the difference in the ancillary appendages. (Pl. XI.) The jointed apophyses of the dorsum have rather straighter tips, and the toothed extremities of the clasps, where the differences between different species of *Lycæna* are most easily observable, have 8 or 9 teeth in *orbitulus*, and 16 or 17 much smaller ones in *pyrenaica*. The smooth, chitinous plate which carries them is of about the same size and form in both species.

At first I thought there was some ground for regarding *orbitulus*, var. *oberthüri*, as also a distinct species, but a larger number of specimens showed this not to be so. The round head of the clasp in *orbitulus* (Pl. XII, Arolla specimen) and the more beak-shaped one of *oberthüri* (Lac de Gaube specimen, Pl. XIII) are the result probably of slightly different orientations of the specimens on the slides, as other specimens show beaked heads in Swiss specimens and round-headed ones for the Pyrenees.

It is also the case that in a considerable series I find little difference in the wing characters of the imagines, and examples from the Simplon are as large as the largest *oberthüri*. Simplon 35·0 mm. *Oberthüri* 34·0 mm.

M. Oberthür has said nearly all there is to say as to the distinctness of *pyrenaica* and *orbitulus*; it is but fair to say that M. Pierret, sixty years ago, was equally definite in correction of M. Boisduval, he said nothing about *E. lefebvrei* being a good species, because he saw no reason to suppose any one could entertain any other opinion; and such a question would probably never have arisen but for German objections to French forms being considered good species.

M. Pierret says *orbitulus* of the Pyrenees is quite like that of the Alps. M. Oberthür says they are larger and more robust. Looking at my series of both, I come to the apparently absurd conclusion that both are right. Except the Simplon specimens, M. Oberthür's dictum is correct. Including these, there is no *orbitulus* from the Pyrenees that cannot be very fairly matched by one from the Alps. Yet in the mass they look different, apart from size. Again excepting the Simplon specimens, the Alpine form has the base of the wings blue, the margins dark, and the one grades insensibly into the other. The Pyrenæan specimens have the centre of the wings blue, with a broad dark margin tolerably well defined generally on the hind-wings, rarely marked on the fore-wings. This refers to the mass of specimens but each group has individuals more or less of the other type. They are then somewhat distinct races, but neither has any specimens that cannot be very nearly matched from the other race. The Simplon race are, however, var. *oberthüri* quite as much as those from the Pyrenees. It is also the case that the Alpine specimens, besides being smaller than *oberthüri*, have some very small specimens, one as small as 22·0 mm.

The smallest *oberthüri*, a ♀, being 30·0 mm. The smallest specimens are from Dauphiné and the Engadine. The legends under the Plates, with the above descriptions, sufficiently describe them.

Explanation of Plates VIII—XIII.

[*See Explanation facing the* Plates.]

XIV. *On* Stenoptilia grandis (*new species*). By T. A. Chapman, M.D., F.Z.S.

[Read April 1st, 1908.]

Plates XIV—XVII.

Certain groups of the Stenoptilias are not too easy to separate correctly into their component species. The gentian-feeding section is perhaps one of the most puzzling of these. Probably our *S. zophodactylus* is the most distinct.

But **graphodactylus* and *coprodactylus* seem to me to be extremely difficult to discriminate, so much so, that I am not very clear as to what facts I could rely on in reply to any one who asserted them to be identical.

In their most pronounced and typical forms they are sufficiently different, but there have passed through my hands specimens that were more or less intermediate, or though apparently belonging to one species, presented characters supposed to be distinctive of the other.

If there is only one species, then the form that is the subject of this note is another form of it. But if *graphodactylus* (*pneumonanthes*) be distinct from *coprodactylus* then *S. grandis* is undoubtedly a third species.

It is characterised by its large size (exp. al. 30 mm.), and by the transverse pale marking on the upper plume of the fore-wing. In *graphodactylus* (*pneumonanthes*), Pl. XIV, fig. 6, this line is fairly transverse and not far from the middle of the separate part of the plume.

In *coprodactylus* (Pl. XIV, figs. 5 and 7) this line tends to be oblique and to be nearer the apex of the wing than in *graphodactylus*, but still running back internally, as if to reach the fork between the plumes. On *grandis* (Pl. XIV, fig. 4) this difference is extreme, the oblique line is well beyond the middle of the plume, and is very oblique, almost seeming to run from the apex to the middle of the inner border of the plume.

This line varies a good deal in different specimens of *graphodactylus* and *coprodactylus*, but in obliquity and

* I do not propose to discuss the relation of *pneumonanthes* and *graphodactylus*.

approach to the hind margin, no specimens I have seen of either species are at all near to *grandis* in this respect. *Grandis* agrees with *coprodactylus* in the inner dark half of the fringe (continuous in *graphodactylus*), being broken up into spots.

On examining the ancillary appendages for some indication as to the relationship of these forms, one is met by the remarkable fact, that there is very little difference in these structures in the several species. The clasps are very remarkable and complex structures, but except in some slight differences in proportions and curvatures are quite alike not only in these gentian-feeding species, but species of other groups such as *pterodactylus* and *bipunctidactylus* are practically the same.

I find, however, certain differences in the tegumen that appear to be constant. These will be best understood by reference to the plates (XV); it will be seen that the tegumen of *grandis* has little affinity with that of *coprodactylus*, and is much more of the type of that of *graphodactylus*.

There is another difference that is of considerable importance, viz. the great size of these appendages in *grandis*, as compared with the other two species. (Compare Plates XVI and XVII, where all are equally magnified.) Were *grandis* merely an aberrational form, the large size of the imago generally would be accompanied with appendages of normal size. It is at least the rule for the appendages to preserve a normal development, notwithstanding great variation in size otherwise, so far as my observations go. This is true of specimens from the same region, but not always of geographical varieties, as of Swiss and British *Erebia æthiops*.

It is certain that though *coprodactylus* occurs on the same ground with *grandis*, it is physically impossible for them to be syngamic, nor as a matter of fact were any intermediate specimens taken. These specimens of *grandis* were taken July 29th, 1905, on the top of one of the spurs of the hill opposite Larche, Basses Alpes, at a height of rather over 6,000 feet. Some were taken on the wing, others were bred from pupæ found together with empty cases on the leaves of *Gentiana lutea*. It was remarkable that no trace of where the larvæ had fed on the plants could be found; the plants were almost all the large clumps of root leaves, without flowering stems; though a few had

flowering stems, the pupæ were quite unassociated with these and were usually on the mid-rib about the middle of the upper side of a leaf.

Except in size these pupæ differ very little from the others of the group.

I append a note on the pupa.

The pupæ were found on the centre of leaves of *Gentiana lutea*, altogether 14 were found, full, empty—good and bad—always near the centre of leaf, usually on the mid-rib, on upper surface and as usual head downwards. They are 12 to 13 mm. long. Thoracic portions rather swollen, 2·3 mm. wide, about 2 mm. from meta-thorax backwards, but with a falling in of sides (dorsally) of forward abdominal segments and meta- and portion of meso-thorax that gives an appearance to abdomen of being spindle-shaped, it tapers off very regularly in last four segments to a rather sharp point. The falling in of sides is in accentuation of the prominence of dorsal ridges in a hump on posterior margin of dorsum of 2nd thoracic.

Seen laterally, the pupa is straight ventrally—dorsally arches back from nose-horn to the hump on meso-thorax, then fuller to 1st abdominal whence it is fairly straight till last four segments. The dorsal ridges arch outwards on middle of mesothorax and form an elliptic raised surface, thence (*i. e.* from hump) they separate, especially on 1st abdominal and end at II of 3rd abdominal. There are no hairs, but there are points marking I and II on abdominal. The colour is green of most of abdomen tending to ochreous at last segments and also on meta-thorax and 1st abdominal; forwards it is overlaid by whitish, so that on front view the pupa is white. The appendage-cases are dark, getting nearly black in some pupæ; 2nd and 3rd legs form a free style beyond end of wings, down to middle of 6th abdominal. The venation of wings is marked, and the whole surface is finely ridged transversely. The pupa is like a large, robust *zophodactylus* pupa less richly coloured.

I have also a solitary specimen from Pajares (Asturias, Spain) that is paler than the French ones, and in facies suggestive of *coprodactylus*, but agrees in essential markings and in size with *grandis*; being a solitary specimen, I have not examined the appendages, but believe there is no doubt the specimen is specifically identical with those from Larche.

Hofmann notes under *coprodactylus*: "Male specimens from the Alps are often very large, remarkably pale and little marked; three very dark large specimens in Reutti's

collection came from Hohenkapf in Allgäu. I took a precisely similar specimen near Kelheim on June 3rd."

It is very possible that the dark specimens noted belonged to *grandis*, this is the only reference I have found to the species having possibly been observed.

S. graphodactylus is said to feed on *Gentiana lutea*, the food of *grandis ; coprodactyla* on *Gentiana verna*. As an abundant and wider spread species, it is probable that the latter feeds on various gentians, *verna*, *acaulis*, etc., *lutea* being more likely an exception than not.

That *S. grandis* should be attached to the supposed food of *S. graphodactyla*, and at the same time more nearly resemble *coprodactyla*, may equally point to the three forms being distinct, or to all being races of one species.

Explanation of Plates XIV—XVII.

[*See Explanation facing the* Plates.]

XV. *A Contribution to the Classification of the* Coleopterous *family* Dynastidæ. By Gilbert J. Arrow, F.E.S.

[Read March 4th, 1908.]

The Dynastidæ flourish most in the New World, they are fairly well represented in Australia, but appear to be least numerous in the Oriental Region and particularly upon the Continent of Asia. As those which do occur are generally abundant and attract attention by their forms and size it is strange that this sufficiently small group has been little studied as regards classification. The American species by their numbers and difficulty rather repel systematic workers, and the Australian and African representatives have received considerable attention in recent times, but the Asiatic species have been neglected and their classification is in considerable confusion, rendered greater by the fact that some of the old genera in which they are included have been divided and reconstituted as regards species from other regions. The present paper, although it contains descriptions and synonymical notes based upon specimens in the British Museum from all parts of the world, deals more especially with Oriental representatives of the family. All the new species described here are represented in the British Museum collection.

The Oriental species at present standing in the genus *Heteronychus* are in urgent need of revision. Many African species formerly placed in the genus have been formed into new genera by Messrs. Kolbe and Péringuey, and those that remain from that region form a fairly homogeneous series, but this is by no means the case with the Oriental species. One of the most distinctive features of the genus is the peculiar smoothness of the pronotum, which is without trace of elevation or depression behind the head and entirely, or almost entirely, without punctuation. This characteristic is accompanied by a form which is not highly convex, by the presence of a pair of stridulating files upon the propygidium, and, in the male, by the thickening of the anterior tarsus and enlargement of its inner claw, which has a very broad basal

tooth. In all other respects the genus agrees with *Pentodon*, the front tibiæ have several secondary denticles in addition to the three strong teeth, the hind tibiæ are truncated and setose and the mandibles are deeply notched externally. This definition (which is not materially different from that of Lacordaire), although it fits the African and Madagascan species, excludes most of the Asiatic ones at present assigned to *Heteronychus*. These are *H. morator* and *piceus*, F., *javanus* and *pauper*, Burm., *simplex*, Waterh., *annulatus* and *poropygus*, Bates, *Lansbergi*, Schauf., *deserti*, Heyd., and *bidentulus*, *cribratellus*, *curtulus*, *interruptus*, *monodon*, *punctolineatus* and *sumatrensis*, Fairm.

In addition to the above *H. cribratellus*, Fairm., another species was described from Egypt by the same author under the same name and in the same year. This M. Bedel has already found to be a synonym of *Pentodon syriacus*, Kraatz, and *H. bidentulus* he has rightly referred to the same genus. *H. deserti*, Heyd., may also be a species of *Pentodon*. It is not a *Heteronychus*. The Oriental *H. cribratellus* is one of a group of species in which the pronotum is distinctly punctured and sometimes slightly impressed in front, and in which the front tarsi are not thickened in the male, and for these it is necessary that a new genus should be formed. It may be defined as follows:—

Alissonotum, n. gen.

Mandibles strongly notched externally. Clypeus attenuated and bidentate at the end, bearing behind a transverse bi-tuberculate carina. Pronotum distinctly punctured, sometimes slightly impressed at the middle in front, not closely fringed at the sides. Front tibiæ 3-dentate, with minute secondary denticles. Front tarsi and claws not thickened in the male. Propygidium bearing two microscopic stridulating files.

Only the last feature and the strongly striated elytra clearly distinguish this genus from *Pentodon*. In that there are sometimes traces of a double series of ridges upon the propygidium but the files are always very coarse and imperfect and the ridges do not nearly reach the hinder margin of the segment. The recognised species of *Pentodon* are very homogeneous in size and form and are essentially Palæarctic in distribution, whereas the present

group consists of smaller species of rather varied form and is apparently confined to Tropical Asia. The type species is *Heteronychus piceus*, F. (= *Phileurus detractus*, Walk.), and I refer to it also *H. cribratellus*, Fairm., *H. pauper*, Burm. (= *H. simplex*, Waterh. and *H. interruptus*, Fairm.) and the following new species:

Alissonotum crassum, sp. n.

Robustum, ovatum, nigrum aut nigro-piceum, capite crebre punctato-rugoso, fronte sat fortiter bituberculato; prothorace fortiter et crebre punctato, medio lævius, disco antice lævissime impresso et tuberculato; scutello impunctato; elytris fortiter striatis, stria prima vix punctata, cæteris grosse irregulariter punctatis, interstitio primo confuse punctato, 3° et 5° partim seriato-punctatis, lateribus minute, apicibus grosse et crebre, punctatis; propygidio leviter rugoso, postice medio producto; pygidio parce punctato.

Long. 19–21 mm. Lat. max. 11 mm.

Hab. Assam: Silhet; Burma: Bhamo, Tenasserim.

This is a large, black, oval insect. The head is coarsely rugose and bituberculate above. The prothorax is closely punctured, the punctures being coarse except along the middle, where they are fewer and finer. There is a faint impression near the middle of the anterior margin and a minute elevation in front of it. The scutellum is broad and smooth. The elytra are deeply striated, the sutural stria being scarcely punctured and the remainder rather strongly. The first interval is very broad and irregularly punctured and the 3rd and 5th have each an incomplete line of punctures. The outer margins are finely, and the extremities coarsely, punctured. The propygidium is produced in the middle and bears two long and finely striated files. The remainder of the surface is finely rugose and pubescent. The pygidium is rather finely punctured. The sexes are alike.

Alissonotum impressicolle, sp. n.

Ovatum, nigrum, nitidum, capite crebre rugoso, bituberculato; prothorace fortiter haud dense punctato, medio subtilius, antice lævissime impresso et elevato; scutello impunctato; elytris fortiter punctato-striatis, striæ primæ punctis toto confluentibus, interstitio primo irregulariter, 3° et 5° lineare, punctatis, lateribus et apicibus

crebre punctatis; propygidio postice leviter producto, pygidio sat grosse punctato.

Long. 14 mm. Lat. max. 8 mm.

Hab. Burma: Bhamo, Teinzo (*L. Fea.*).

This is almost of the same size and shape as *A. piceum*, F., but a very little larger and more elongate. It is black and shining with the legs and underside piceous. The head is closely rugose, bituberculate in front and armed on the vertex with two tubercles placed moderately far apart. The prothorax is very distinctly but very closely punctured, the punctures being finer in the middle. There is a faint impression just behind the middle of the front margin and a slight elevation in front of it. The scutellum is broad and unpunctured. The elytra have each a very deep, not distinctly punctured, sutural stria and four pairs of strongly punctured striæ, the 1st and 7th interstices being irregularly punctured and the 3rd and 5th having each an incomplete line of punctures. The outer and apical margins are strongly and closely punctured. The propygidium is slightly produced and bears a pair of fine and moderately broad files. The pygidium is strongly but not closely punctured. The sexes are alike.

So far as can be judged from the descriptions, two species from Kashmir, strangely ascribed by Fairmaire to *Philcurus* (*P. binodulus* and *curtipennis*, Fairm.) also belong to this genus.

For *Heteronychus monodon*, Fairm., and certain other undescribed species, I have found it necessary to make another new genus.

Microrycres, n. gen.

Clypeus attenuated in front, with the margin feebly notched and reflexed. Mandibles strongly notched externally. Front transversely carinate with a single slight median tubercle. Prothorax simple, punctured and bearing a rather long hairy fringe at the sides. Elytra membranous at the apical margins. Front tibiæ 3- or 4-dentate, without intermediate denticles. Front tarsi slender and claws equal in both sexes. Propygidium without paired stridulating files.

Microryctes kanarensis, sp. n.

Niger, nitidus, elongatus, capite crebre punctato-rugoso, antice

anguste rotundato, lævissime bifido, carina transversali frontali vix distincta, medio minute tuberculato, prothorace quam latitudine paulo breviore, toto simplice, disco vix perspicue, lateribus fortiter sat grosse punctatis ; scutello lævi, medio sulcato ; elytris profunde sat regulariter striato-punctatis, interstitiis omnibus impunctatis, lateribus postice apicibusque grosse et irregulariter punctatis, margine apicali prope angulum paulo abbreviato, appendice membranaceo distincto munito ; propygidio parce punctulato et setoso, pygidio fortiter sat crebre punctato ; tibiis anticis 4-dentatis.

Long. 15 mm.

Hab. S. India : Kanara.

It is rather elongate, black, shining and strongly sculptured. The head is strongly and rugosely punctured, with the front of the clypeus feebly bifid and the frontal tubercle not very strong. The prothorax has very minute scattered punctures on the disc, and these become rather abruptly coarse at the sides. The scutellum is unpunctured and longitudinally impressed down the middle. The elytra are very strongly striate-punctate, all the interstices being unpunctured and nearly equal, except the juxta-sutural strip, which is narrow. The sides and apices are strongly and irregularly punctured. The apical margins are slightly truncated obliquely at the inner half and continued on a membranous flange. The propygidium is very finely and sparingly punctured and the pygidium very coarsely and thickly. The front tibiæ are furnished with three strong pointed teeth and a vestige of a fourth upper one.

Two female specimens were collected by Mr. T. R. D. Bell.

Microryctes apicalis, sp. n.

Parvus, sat elongatus, niger, nitidus, corpore subtus rufo-piceo, capite crebre punctato-rugoso, antice anguste rotundato, lævissime bifido, carina frontali transversali medio leviter tuberculata ; prothorace sat angusto, angulis anticis paulo productis, posticis haud late rotundatis, disco minute, lateribus fortiter sat grosse punctatis ; scutello lævi, medio sulcato ; elytris profunde striatis, striis latis, confuse punctatis, lateribus postice apicibusque grosse irregulariter punctatis, apicibus conjunctim sat profunde emarginatis, appendicibus membranaceis ; propygidio minute irregulariter strigoso, parce

setoso; pygidio grosse et crebre punctato; tibiis anticis acute tridentatis.

Long. 11·5 mm.

Hab. Burma: Carin Cheba (*Fea.*).

Two specimens, both males, were found at an altitude of 900–1,100 m. in December 1888.

The species is very like the preceding but smaller and the prothorax is relatively narrower, the front angles sharper and the hind angles less broadly rounded. The elytra are very coarsely and deeply punctate-striate and the membranes to which their apices become abruptly reduced are broad and conspicuous. The pygidium is very strongly punctured and the front tibiæ sharply tridentate, without trace of an additional tooth as in the other two species.

M. monodon, Fairm., was described from Cochin China but two specimens brought by Signor Fea from Rangoon are almost certainly indistinguishable from it. The membranous apices of the elytra, which are the most peculiar feature of the genus, are not mentioned by Fairmaire, but in this species they are so slight as not to attract attention.

Of the remaining Oriental forms attributed to *Heteronychus*, *H. morator*, F., *javanus*, Burm., *sumatrensis*, Fairm., and *Lansbergei*, Schauf., are obviously very distinct from it. The last is unknown to me, but the others are congeneric, and for these and other species undescribed I constitute the following new genus:—

Pseudohomonyx, n. gen.

Mandibles broad, prominent, not acuminate; rounded or gently sinuated at the side. Maxillæ armed with four strong equal teeth. Labium smooth, sulcate behind, broad and sinuated in front, with the palpi inserted at the margins. Clypeus trapeziform, straight in front, with the angles rounded. Head entirely unarmed in both sexes. Prothorax regularly rounded at the sides, with the posterior angles completely rounded off. Propygidium without stridulating files. Legs very spinose, with the tarsi slender but not long. First joint of the hind tarsus elongate. Front tibia strongly tridentate: middle and hind tibiæ flattened, gently crenate and strongly spinose at the extremity.

♂. The prothorax is impressed in front and there is a median tubercle just behind the front margin. The front tarsi are thickened and the inner claw very broad.

The type species is the following:—

Pseudohomonyx borneensis, sp. n.

Niger, nitidus, elongatus, subtus rufo-hirtus, capite rugoso, medio leviter transversim impresso; prothorace minutissime punctato, parum convexo, basi utrinque leviter impresso; scutello minutissime punctato; elytris fortiter striatis, striis crebre annulato-punctatis, interstitiis dorsalibus convexis, haud perspicue punctatis, lateribus atque apicibus grosse ac crebre punctatis; propygidio subtiliter pygidioque fortiter et confluenter punctatis:

♂, prothorace antice leviter longitudinaliter impresso, margine medio vix tuberculato.

Long. 19-23 mm.

Hab. BORNEO: Sarawak; LABUAN.

This was taken by Dr. A. R. Wallace in Sarawak and by Mr. Hugh Low in Labuan. In size, shape and sculpture it closely resembles *Pseudohomonyx morator*, F. (of which I believe *Heteronychus javanus*, Burm., to be a synonym), but it differs in the very close and strong puncturation of the sides and apices of the elytra and the pygidium and in the less broad and deep anterior impression of the prothorax and feebler marginal tubercle in the male.

There are two other species in our collection from the same region, but as both are represented by single specimens only I prefer for the present to leave them undescribed.

The process of elimination has thus reduced the number of Oriental forms properly referred to *Heteronychus* to four, viz. *H. poropygus*, Bates, *annulatus*, Bates, *curtulus*, Fairm. and *punctolineatus*, Fairm.; and to these must be added "*Phileurus*" *sublævis*, Fairm., of which M. Lesne has kindly examined the type for me.

The species is a common and widely distributed one, but Fairmaire's description, in the statement that there are no stridulating organs and in other particulars, is so misleading that I have redescribed it here.

Heteronychus sublævis, Fairm.

Bull. Soc. Ent. Belg., 35, 1891, p. 123.

Niger, nitidus, ovatus, capite rugoso, clypeo sat lato, medio bidentato, fronte bituberculato, prothorace fere lævi, lateribus arcuatis, antice paulo approximatis, angulis acutis; scutello lævi; elytris sat grosse striato-punctatis, linea suturali subobsoleta, lineis 4 discoidalibus postice abbreviatis, 4 lateralibus integris punctisque irregularibus; propygidii lineis stridulatoriis subtiliter sculpturatis, sat distantibus; pygidio minute et crebre punctato, apice lævi; tibia antica dentibus tribus acutis aliisque minutis armata.

Long. 18·5–22 mm. Lat. max. 9·5–13 mm.

Hab. Assam; Rangoon; Malay Peninsula.

Black or piceous, elongate, oval. The head is coarsely rugose with the front bituberculate, and rather broad at the anterior margin, which bears two minute tubercles placed near together. The pronotum is almost imperceptibly punctured at the sides, with the lateral margins broadly curved and slightly narrowed anteriorly, the front angles acute and the hind angles obtuse. The scutellum is smooth. The elytra show a vestige of a punctured sutural stria and four pairs of lines of strong punctures, the first two pairs abbreviated behind. There are a few similar punctures in the intervals and the lateral and apical borders are strongly and irregularly punctured. The propygidium is scarcely punctured and the stridulating files rather distant and very finely sculptured. The pygidium is finely and densely punctured except towards the apex. The front tibiæ are furnished with three strong acute teeth and supplementary denticles.

♂. The front tarsus is slightly thickened and the inner claw very broad, with a strong basal tooth.

The species resembles *H. punctolineatus,* Fairm., (of which I have been able, by M. Lesne's kindness, to examine a co-type), but the marginal tubercles of the clypeus are placed closer together, the pronotum is less visibly punctured, the stridulating files are finer and farther apart, and the pygidium is more finely and closely punctured.

The following new species is remarkable for its extreme smoothness:—

Heteronychus sacchari, sp. n.

Niger, nitidus, latus, sat convexus, capite rugoso, antice acute bidentato, carina anteoculari medio late interrupta; prothorace basi punctis anguste marginato, præterea toto impunctato, angulis anticis acutis, posticis obtusis; scutello parvo, vix punctato; elytris brevibus, post medium paulo ampliatis, lateribus apicibusque vix perspicue punctulatis, humerisque punctis nonnullis majoribus, dorso striarum vestigiis subtilibus, toto impunctato; propygidio minute punctato, lineis stridulatoriis angustis, pygidio basi dense rugoso, apice fere lævi; tibiis anticis dentibus tribus validis acutis aliisque minutis armatis.

Long. 17–19 mm. Lat. max. 11 mm.

Hab. BENGAL: Rungpur.

Black, extremely smooth, and rather short and broad. The head is rugose, with an inconspicuous carina before the eyes, broadly interrupted in the middle. The clypeus is produced into two rather sharp reflexed teeth. The prothorax is closely punctured along the extreme posterior margin, but is otherwise smooth: it is slightly narrowed in front and regularly rounded at the sides, with the front angles acute and the hind angles obtuse. The scutellum is small and vaguely punctured at the base. The elytra are short, widening a little behind the middle, with faint traces of striæ quite devoid of punctures. There are a very few punctures at the shoulders and the outer margins are very minutely punctulated behind. The propygidium is finely punctured and the stridulating files are narrow, not reaching the hind margin. The pygidium is densely rugose at the base and almost smooth on the apical half. The front tibiæ have three strong acute teeth and intermediate denticles.

In the male the prothorax is rather longer relatively to the elytra and the front tarsus and inner claw are only moderately thickened.

This species is reported as causing considerable injury to sugar-cane.

The most highly developed constituent of the *Heteronychus* group is one which has not at present been associated with this group at all. It is the *Scarabæus Itys*, Oliv., placed by Burmeister in his genus *Stypotrupes*, together with two other species of very different type. Although

according to the Lacordairean system the digitate hind tibiæ relegate this to another section, it is really a transition form nearly allied to *Heteronychus*, and it is necessary to form another new genus for it.

Clyster, n. gen.

Form cylindrical. Clypeus produced and truncate in front, the frontal suture bearing a short recurved horn in the male and two tubercles in the female. Mandibles straight at the sides and blunt in front, not produced beyond the clypeus. Front tibiæ armed with three strong teeth and secondary denticles: middle and hind tibiæ compressed and spinose, digitated at the end. Tarsi moderately slender, the front ones greatly thickened in the male, with the inner claw very broad and cleft at the end. Propygidium rather produced behind, with almost the whole median part finely striated.

Type. *Stypotrupes Itys*, Oliv. (*S. Ajax*, F. = *Dichodontus Renkeni*, Nonf.)

A second species of this genus is here described:—

Clyster retusus, sp. n.

Niger, nitidus, elongatus, convexus, capite rugoso, antice sat anguste producto, truncato; prothorace quam longitudinem parum latiore, omnino marginato, lateribus valde curvatis, antice contractis, angulis anterioribus acutis, posterioribus rotundatis; scutello parum punctato; elytris crebre et fortiter punctatis, lineis quatuor geminatis discoidalibus aliaque suturali, interstitiis lateribusque fortiter punctatis; propygidio medio paulo producto, subtiliter transverse strigoso, pygidio densissime punctato:

♂, capitis cornu brevi, recto apice obtuso; prothoracis basi et dorso postice lævibus, parte antica excavata aut decliva, rugosa, carinis obliquis duabus lævibus divisa:

♀, capite medio bituberculato; prothorace antice paulo impresso, rugoso.

Long. 21-29 mm. Lat. max. 11-15 mm.

Hab. Andaman Is.; Penang.

Black or piceous, elongated and rather convex. The head is coarsely rugose, narrowly produced in front, with the anterior edge nearly straight and slightly reflexed and the angles scarcely rounded. The prothorax is not much shorter than its width, with the sides gently and uniformly curved, narrowed in front, the anterior angles acute

and the posterior ones rounded. It is smooth in the middle but there are large scattered punctures at the sides. The scutellum bears a few small punctures, sometimes forming an angulate line. The elytra are closely punctured, the punctures forming four pairs of lines upon each and a single line bordering the suture, and the intervals are closely and irregularly punctured. The propygidium is gently produced in the middle and the whole median part covered with fine but broken striæ. The pygidium is densely punctured, and the punctures, at least at the sides, tend to coalesce transversely.

♂. The cephalic horn is short and nearly straight. The anterior half of the prothorax is scooped out and divided by two smooth oblique carinæ into three areas which are coarsely rugose. The elevated dorsal part ends abruptly in front and is sometimes slightly produced, but it never extends nearly as far as the front margin.

♀. There is a rudimentary excavation at the front margin of the prothorax and two slight tubercles behind it.

Of the two species of *Stypotrupes* placed first in the genus by its originator, one was described from a fragment and has since remained unknown, and of the second (*S. Endymion*), although described as long ago as 1789, the habitat remains yet unknown. The specimen from Kirby's collection (and now in the British Museum) referred to by Burmeister appears to be the actual type of Olivier.

Yet another species (*S. Candezei*, Voll.) which has no affinity with the others has been added to this genus. It is a form whose nearest ally is undoubtedly the peculiar genus *Oryctoderus*. With this it shares the elongate rectangular form, the broad transverse clypeus, produced in the male, the dilated mentum and the thickened front tarsi of the male. It differs in its strongly sculptured surface, the digitated hind tibiæ and the peculiar armature, etc., and I propose to call it

CERATORYCTODERUS, n. gen.

Both sexes of Vollenhoven's species have been well figured by him and no congener is so far known.

Fairmaire appears to have strangely confused the genera *Heteronychus* and *Phileurus*. While placing in the latter genus the three Kashmir species which I have already removed from it, he transferred *Phileurus chinensis* and

morio, of Falderman, to *Heteronychus*, the former being the insect which he has redescribed as *Trionychus Poteli*, while his *Trionychus assamensis* is *Phileurus planatus*, Wiede. Fairmaire has described the males of these, while the older writers have in each case described the females. *Trionychus*, or more correctly *Rhizoplatys*, is properly an African genus and, with these Oriental *Phileuri*, forms a link between the true *Phileurus* (which is confined to America) and the Pentodontides. The Oriental species form a well-defined genus, for which another new name must be found.

Eophileurus, n. gen.

Elongate and rather depressed. Head obtusely pointed in front, with a single median horn or tubercle. Mandibles produced in front, not notched or toothed. Maxillæ 3-toothed. Labium broad, with the palpi inserted at the inner side. Front tibiæ acutely 3-dentate, without secondary denticulation. Hind tibiæ truncate, strongly spinose. Tarsi slender, with the basal joint in the middle and hind legs produced at the outer edge. The prothorax is generally more or less excavated, at least in the male. The male has the front tarsi thickened and its inner claw broad and cleft; and the head bears a slender, though not long, horn.

The species belonging to this genus are:—*Phileurus planatus*, Wiede. (=*assamensis*, Fairm.), *chinensis*, Fald. (=*Poteli*, Fairm.), *platypterus*, Wiede., *morio*, Fald. *convexus*, Arrow, and the following undescribed forms:—

Eophileurus perforatus, sp. n.

Niger, nitidus, parallelus, haud longus, supra grosse, parum dense punctatus; prothorace antice sat crebre, postice laxe punctato, disco leviter longitudinaliter impresso, lateribus valde curvatis; scutello lævi; elytris seriato-punctatis, punctis annulatis, distinctis, interstitiis minutissime punctulatis; pygidio sat grosse, lateribus rugose, punctato:

♂, capite lævi, polito, cornu sat brevi, gracili, curvato, prothorace ad marginem anteriorem late sat leviter impresso:

♀, capite rugose punctato, medio tuberculato, prothorace æquali.

Long. 19–22 mm. Lat. max. 9–10 mm.

Hab. Southern India: Bombay, Mhow, Belgaum.

Our collection contains a series of male examples and a

single female. One specimen was found by Mr. H. E. Andrewes in the hollow stem of a decayed mango tree.

The species is black, shining and coarsely punctured, the punctures not very numerous on the prothorax, which has a slight longitudinal sulcus at its posterior part, and absent from the scutellum. The elytra bear rows of annulate, moderately-distant punctures and extremely minute punctulations in the interstices. The pygidium is coarsely punctured and the metasternum bears large deep crescentic impressions at the sides and rather fine punctures in the middle, and there are also fine and scanty hairs.

♂. The head is smooth and shining, with a simple slender horn, and the prothorax has a shallow broad impression behind the front margin.

♀. The head is rugosely punctured and bears a tubercle.

E. perforatus resembles *E. platypterus*, Wiede., but is rather larger and much less densely punctured, especially upon the prothorax, which is sparingly, though very coarsely, punctured and bears a longitudinal impression absent in the other species. The scutellum is without the large punctures present in *E. platypterus*. The male is most markedly distinguished by the head, which is smooth with a slender horn, while in the older species it is closely punctured and the horn is laterally compressed.

Eophileurus cingalensis, sp. n.

Niger, nitidus, latus, parallelus, supra dense varioloso-punctatus, capitis cornu brevi; prothorace brevi, lateribus valde curvatis; scutello confuse punctato; elytris grossissime seriato-punctatis, punctis annulatis, interstitiis minutissime punctulatis; pygidio grosse et rugose punctato:

♂, capite parum punctato, cornu brevi; prothorace leviter longitudinaliter impresso, ad marginem anteriorem paulo latius:

♀, capite prothoraceque crebre punctatis.

Long. 20–26 mm. Lat. max. 10–13·5 mm.

Hab. Ceylon.

This is a rather broad species, resembling *E. perforatus*, but larger, more closely and still more coarsely punctured. The prothorax is closely punctured all over and the punctures become confluent in front. The scutellum is confusedly punctured and the elytra are closely covered

with rows of very large ring-shaped impressions, the interstices minutely and scantily punctulated. The pygidium is coarsely and rather rugosely punctured and the metasternum is decorated with large crescentic impressions, except at the middle which is almost smooth. It bears only a few tawny hairs.

♂. The head is scantily punctured and bears a very short horn in the middle. The prothorax has a faint longitudinal impression which becomes a rather feeble semicircular fovea behind the front margin.

Eophilcurus nilgirensis, sp. n.

Niger, nitidus, latus, depressus, prothorace minute sat crebre punctato, lateribus valde arcuatis, angulis posticis fere acutis; scutello minute punctato; elytris crebre seriatim punctatis, punctis annulatis haud profundis; pygidio basi rugoso, apice leviter punctato:

♂, capite lævi, cornu haud longo; prothorace antice fortiter circulariter impresso, postice vix sulcato:

♀, capite prothoraceque antice transverse rugosis.

Long. 22–24 mm. Lat. max. 12·5 mm.

Hab. S. India: Nilgiri Hills, 6,000 ft.

Collected by Captain A. H. Weld Downing and Mr. H. L. Andrewes, by whom the ♀ was dug up in the jungle. *E. nilgirensis* is very nearly related to *E. planatus*, Wiede., but much less finely punctured and the prothoracic fovea in the male is circular, extends in well-developed specimens considerably past the middle and is not bounded behind by distinct angulations. The prothorax is closely punctured, becoming rugose in front, and the sculpture is only a little coarser than in *E. planatus*. The sides are strongly rounded but the curvature does not quite reach the posterior angles, which are rather sharp. The scutellum is irregularly punctured. The elytra are closely covered with coarse annular punctures arranged in definite rows and there are a very few minute punctulations in the interstices. The pygidium is rugose at the base and scantily punctured at the apex and the metasternum is densely punctured and clothed with long tawny hair, except in the middle, where it is scantily punctured and bare.

It will be well, in passing, to call attention to an error in connection with certain species of *Phileurus* properly so-

called. Burmeister, in his description of *Phileurus vervex*, has included two species, the characters of the male being taken from one and those of the female from the other. The *P. vervex* of Dejean's Catalogue is an Argentine species and is peculiar for its very prominent smooth pygidium. It is this which Burmeister has described as the male. The female has the pygidium equally prominent and smooth, but its ventral part is slightly excavated, forming an overhanging ridge above, and the last ventral segment, as usual in the Dynastidæ, is broader and not emarginate at the apex as in the male. There is another species, occurring in Brazil, Guiana, Bolivia, Peru, etc., which closely resembles the Argentine form but has a flatter and more deeply grooved prothorax, the groove not widening into a large fossa in the male, as it does in the other species. The pygidium is only moderately convex and is very coarsely and thickly pitted in both sexes. This form has been described by Burmeister as the female of *P. vervex*. I desire to rename it—

Phileurus Burmeisteri, sp. n.

I prefer to apply the name of *P. vervex* to the Argentine species, although Burmeister has quoted the habitat of the other alone, because the name was first given (by Dejean) to an insect from Buenos Ayres, and because Burmeister has described both sexes of that species although mistaking the females for males of minor development.

My type of *P. Burmeisteri* is from Rio Janeiro.

The new genus which follows is necessary for an isolated and interesting African species as yet undescribed. It belongs to the Cyclocephalinæ, one of the most characteristic Tropical American groups of beetles, of which it forms the only known representative in Africa. Like others of that group it very closely approaches the Rutelidæ both in appearance and structure.

RUTELORYCTES, new genus.

Form elongate, not very convex, with rather slender legs. Clypeus large, broad in front and not toothed. Head entirely unarmed. Labrum concealed, hardly corneous. Mandibles small, simple, not produced or notched. Maxillæ almost naked, armed at the inner edge with 6 long and sharp teeth: palpi moderately long. Labium

elongate, with a distinct, bilobed, strongly chitinised ligula. Prothorax entirely simple. Prosternum forming a very prominent finger-like process behind the front coxæ. Propygidium without stridulating apparatus. Front tibiæ 3-dentate, the four posterior ones narrow, spinose (not digitate) at the extremity. Basal joint of the tarsi not dilated.

♂. Clypeus shorter and broader. Front tarsi thickened, with the inner claw broad and minutely cleft.

Rutelorycter tristis, sp. n.

Glaber, niger, nonnunquam lævissime æneus, elongato-ovatus, inermis, clypeo lato, antice reflexo, minute sinuato, rugose punctato, fronte fortiter laxe punctato ; prothorace similiter punctato, lateribus leviter arcuatis ; scutello haud acuto, minutissime punctato ; elytris haud grosse, sat æqualiter, annulato-punctatis ; pygidio minute et densissime punctulato ; corpore subtus medio lævi, metasterni lateribus rugosis, abdominis lateribus irregulariter punctatis, transverse ciliatis :

♂, pygidio majore, convexo :

♀, elytrorum marginibus lateralibus ante medium obtuse angulatis, superficie postica minute et dense punctulata.

Long. 16–21 mm. Lat. max. 9–11·5 mm.

Hab. Sierra Leone ; Portuguese Guinea : Bissao (Favarel).

There are several specimens in the British Museum and M. René Oberthür's collection.

It is very much like the species of the American genus *Dyscinetus*, to which it is closely related, and might be regarded as a representative of that genus which has strayed across the Atlantic. The prothorax is rather more closely adapted to the hind-body than is usually the case in *Dyscinetus* and its posterior angles are not rounded off. The pygidium also is larger, more convex and less prominent. Perhaps the most interesting and peculiar feature is one found only in the female, in which sex the whole of the posterior part of the elytra is closely and microscopically punctured.

Mr. Péringuey has made a genus (*Venedus*), for *Heteronychus paradoxus*, Boheman, supposing his only example to be a male ; but both genus and species are redundant, being based upon the female of the curious *Xenodorus Janus*, F., which occurs on the Gold Coast, in the Congo, Angola, Natal, etc.

Heteronychus fovcipennis, Fairm., may be placed in the genus *Anodon*. It is probably not distinct from *Lonchotus muticus*, Burm. In addition to the last misplaced species, only three species of *Lonchotus* have been described, although they appear to be rather numerous. Two, which are represented in the Museum by series consisting of both sexes, are described here.

Lonchotus punctatissimus, sp. n.

Niger, vel nigro-piceus, convexus, modice elongatus, capite crebre rugoso, antice minute haud acute bidentato ; prothorace baseos medio excepto dense punctato ; scutello impunctato ; elytris stria suturali crenata completa lineisque sex postice abbreviatis punctarum ocellatarum, punctis magnis crebris, externis magis irregularibus, interstitiis alternis punctis nonnullis, sculpturatis, lateribus lævibus, apicibus modice haud profunde punctatis ; propygidio subtilissime transversim strigoso, pygidio sat minute punctato, apice fere lævi ; metasterno creberrime rugoso et rufo-hirto :

♂, breviter acute cornuto, cornu recurvato ; prothorace profunde sat anguste excavato, fossæ lateribus acute carinatis, antice et post medium utrinque obtuse dentatis, fundo undique transverse ruguloso.

Long. 25–27 mm. Lat. max. 14–15 mm.

Hab. Central Madagascar : Ambohimitombo Forest, 1,200 m.

This closely resembles *L. lentus*, Burm., but is larger and differs by the distinctly bidentate clypeus, more rugose head, and much more strongly and closely punctured pronotum, the excavation of which in the male is a little broader. The puncturation of the elytra is very similar, but rather more distinctly linear. The most strongly marked difference is to be found in the stridulating surface of the propygidium, which in *L. lentus* is comparatively coarse and in the present species is extremely fine.

Lonchotus politus, sp. n.

Niger, nitidus, convexus, sat breviter ovatus, capite dense punctato, antice obtuse acuminato ; prothorace punctato, postice medio fere lævi ; scutello impunctato ; elytrorum parte antica late haud profunde punctata, stria suturali antice obsoleta, apicibus leviter punctatis, aliis locis lævibus ; propygidio subtilissime transversim

strigoso, pygidio fere lævi, lateribus solum paulo punctatis; metasterni lateribus dense punctatis et rufo-hirtis:

♂, lateribus magis parallelis, capite breviter acute cornuto, cornu recurvato; prothorace profunde excavato, fossæ lateribus carinatis, antice et post medium utrinque obtuse dentatis, fundo haud fortiter rugoso.

Long. 22–25 mm. Lat. max. 12–14 mm.

Hab. S. Madagascar: Fort Dauphin.

A number of examples, chiefly females, were collected by Mr. G. F. Scott-Elliot. This species also is much like *L. lentus*, Burm., and of the same size and shape, but is very readily distinguishable. It is remarkable for the feeble and scanty puncturation of the elytra, the punctures scarcely extending beyond the middle and not forming regular rows. The propygidium is very finely striated, as in *L. punctatissimus* and the pygidium almost smooth, although more punctured in the female than in the male, as in all the species. The prothorax of the male is more deeply and broadly excavated than in either of the other species I have named and the sides are more closely punctured than in *L. lentus*, but less so than in *L. punctatissimus*.

In the African genus *Pycnoschema* the pygidium and propygidium are generally densely covered with pubescence in the female and sometimes in the male also. In certain species the males exhibit traces in this region of a fine transverse striation on each side of the median line, representing the stridulating organ of *Lonchotus* and many other genera, although scarcely in a sufficiently perfect condition to be functional. In a new East African species, however, this structure is well developed. I have described this species as follows:—

Pycnoschema musica, sp. n.

Rufo-picea, nitida, elongata, subcylindrica, capite in utroque sexu acute cornuto, clypeo sat longo, parum punctato, medio dilatato, cantho fere quadrato, fortiter punctato; prothorace fortiter inæqualiter punctato, lateribus et dorsi medio parcius atque subtilius, undique valde marginato, angulis omnibus obtusis; scutello parcissime punctulato; elytris haud profunde geminatim striato-punctatis, interstitio primo marginibusque postice irregulariter sat crebre, reliquis parcissime, punctatis:

♂, capitis cornu longo gracili recurvato, fronte parce punctato; prothorace antice lato, lateribus paulo deplanatis, antice medio excavato lævi, dorso antice carinato, medio obtuse bidentato; propygidio medio subtilissime transverse strigoso, linea mediana lævi; pygidio convexo, subtilissime punctato-rugoso, medio minus dense; tarsis anticis crassatis:

♀, capitis cornu brevi, sed acuto, fronte fortiter punctato; prothorace antice magis angustato, crebre punctato, lateribus postice fere parellelis; propygidio dense fulvo-piloso; pygidio medio vix punctato, parum convexo.

Long. 19–24 mm. Lat. max. 9·5–11·5 mm.

Hab. NYASALAND: Kambole, Fwambo.

A series of specimens was collected between 1892 and 1895 and presented to the British Museum by Mr. W. A. Nutt.

The colour is a very deep shining chestnut and the form narrow and parallel-sided. The horn of a well-developed male is longer than in any other species of *Pycnoschema* known to me and very slender and strongly curved. The female has a short sharply-pointed horn and not, as in many of the species, a cusped carina. In the type (♂) the dorsal carina of the thorax is produced and emarginate in the middle, overhanging the anterior cavity, but in a smaller male it is quite feeble. The propygidium of the female is finely granulated and densely pubescent, but that of the male is quite bare, with two finely and transversely striated bands in the median part.

Pycnoschema palpalis, sp. n.

Castanea vel rufo-castanea, modice elongata, paulo depressa, sat nitida, supra grosse punctata, subtus longe fulvo-pilosa, metasterni medio crebre punctato, lateribus subtiliter rugosis; palporum omnium articulis ultimis magnis:

♂, capite punctato-rugoso, medio læviore, cornu brevi armato, ante oculos sat late producto; prothorace lato, supra undique grosse punctato, antice retuso, margine supero carinato, medio obtusissime biangulato, lateribus post medium valde rotundato-angulatis, basi leviter trisinuatis; scutello minute punctato; elytris post medium lævissime dilatatis, punctis grossis lateraliter irregularibus sat densis, medio geminato-seriatis, punctulisque minutis interspersis; pygidio longe fulvo-hirto:

♀, capite rugoso, medio transverse carinato, carina medio vix

tuberculata ; prothorace dense sat grosse punctato, lateribus medio minus angulatis ; elytris grosse punctatis, punctis aliquibus indistincte geminato-seriatis, punctulis minutis interspersis ; pygidio subtiliter punctato-rugoso, nudo.

Long. 12–14 mm. Lat. max. 6–7·5 mm.

Hab. Abyssinia ; Uganda, Fort Ternan ; British East Africa, Naitolia ; Upper Congo.

It is a small species which seems to be nearly related to *P. rudis*, Raff., described from a single female, but the prothorax has no trace in that sex of the bidentate dorsal carina found in *P. rudis*. The punctures of the head, prothorax and elytra are extremely coarse and annulate, those of the middle of the elytra forming double rows, which are rather indistinct in the female. The transverse carina upon the head of the female is scarcely visibly tuberculate. The last joint of both the maxillary and labial palpi is very large and deeply channelled in the male.

Phyllognathus stricticeps, Fairm., is a species of *Pycnoschema*, the narrow constricted clypeus from which it is named being the principal differential feature of the genus.

The species of the genus *Temnorrhynchus* are very feebly differentiated from one another and the difficulty of identifying them is not diminished in the case of the South and East African forms by the fact that several authors have dealt with them without apparent knowledge of each other's work. The most widely distributed of all is that described by Fairmaire in 1868 as *T. antiochus*, which appears to range from Abyssinia to Natal. It is said by Fairmaire to be the *Coptorrhinus antiochus* of Dejean's Catalogue, but the latter is a Senegal insect, and, according to a specimen from the Dejean Collection in the British Museum, is the form called by Fairmaire *T. Diana*, Beauv. The East African insect was named *T. Diana*, var. *zansibaricus* by Kolbe in 1887 and in 1897 was quoted by him as *T. sansibaricus*, Kolbe. Finally Mr. Péringuey in 1900 renamed it *T. Faunus*. He also ascribed to it, I think rightly, the insect described and figured by Klug as the female of his *T. clypeatus*.

The genus *Podalgus* has been the subject of very great confusion. It occurs first in Dejean's Catalogue for the undescribed West African species *P. cuniculus*, and genus

and species were first described by Burmeister, who quoted the genus as *Podalgus*, Dej., and added to it a number of American insects of which he afterwards transferred most to a new genus, *Ligyrus*. In 1859 Reiche, regarding Burmeister's first species, *Podalgus bonariensis*, as the type of the genus, renamed the African one *Vertumnus cuniculus*, employing, however, a generic name already preoccupied. Lacordaire had previously confined *Podalgus* to *cuniculus* alone and observed that Burmeister's *P. bonariensis* and *P. obesus* belonged to a new genus. The latter about the same time became the type of Leconte's genus *Aphonus*. I consider that *P. cuniculus*, Burm., should undoubtedly be taken as the type of *Podalgus*, which is a very distinct genus peculiar to the desert tracts of Northern Africa and Western Asia. I have seen examples from the Punjab, Bokhara, both shores of the Red Sea, Abyssinia and Northern Nigeria, and there is a remarkable degree of similarity of form and sculpture in all. The Bokhara form has been named *Crator infantulus* by Semenow, but Fairmaire has pointed out that this generic name also is redundant.

Podalgus bonariensis, Burm., is not congeneric with *Aphonus obesus*, Burm., as Lacordaire believed, and although not transferred to *Ligyrus* by Burmeister himself on account of the absence of a stridulating patch on the elytron, I have found no other reason for its exclusion. Its general form and features are those of *Ligyrus* and the margins of the elytra are closely studded beneath with minute tubercles which no doubt correspond to the stridulating file of typical species.

Three species treated by Burmeister as a section of *Dyscinetus* (*D. rostratus*, Burm., *Zoilus*, Oliv., and *nasutus*, Burm.) have a stridulating patch beneath each elytron exactly like *Ligyrus*, and the form of the head and thorax also show a greater degree of relationship to that genus than to *Dyscinetus*. They really form a quite distinct genus, which is characterised as follows:—

Oxyligyrus, n. gen.

Form cylindrical. Head acuminate in front, with the tip sharp and reflexed, and the frontal suture marked by a carina interrupted in the middle. Mandibles not toothed externally, with the apices straight and slightly prominent. Prothorax more or less impressed and tuberculate behind the front margin. The inner surface of the

elytra bearing a stridulatory area as in *Ligyrus*. Legs rather short and stout, the front tibiæ bearing three short, equal, and closely set teeth at the outer edge, the four posterior tibiæ flattened. Tarsal joints similar.

♂. Front tarsi thickened and contracted, with the penultimate joint produced into a broad striated plate and the inner claw thickened and feebly cleft.

Type, *Chalepus rostratus*, Burm.

Mr. Linell used the name *Pseudoryctes* in 1898 for a new genus which he formed for *Oryctes patagonicus*, Waterhouse, but as the same name was adopted in 1873 for a very different genus of Australian Dynastidæ I propose to substitute NEORYCTES for the South American genus.

The Australian genus *Adoryphorus* was formed by Mr. Blackburn for a single species of Burmeister's (*Dasygnathus Couloni*) and both authors confess ignorance of the male, but the slight tubercle at the back of the head, mentioned in both the very brief descriptions, is distinctive of the male and it therefore seems that both entomologists, looking for some more salient indication of that sex, described the male of this insect as the female. As our collection contains a good series of both sexes I may supplement the few published characters by giving the sexual distinctions. The male is parallel-sided and the female ovoid, the body dilating from the clypeus to near the end of the elytra. In addition to the tubercle upon the vertex of the head in the male, the clypeus is shorter, and the prothorax is much shorter and relatively broader. As usual in the Dynastidæ the last abdominal segment is more or less triangular in the female and emarginate behind in the male.

The essential features by which this genus differs from *Dasygnathus* have not been pointed out, and when the species of this large Australian group are more fully known it may perhaps not be possible to retain it.

Mr. Blackburn is probably right in supposing *Scapanes solidus*, Burm., to be the insect for which he has made another genus, *Ascmantus*, but he is not right in calling it *Ascmantus subæqualis*, Hope. I have ascertained the type of the latter (in the Oxford Museum) to be the same species as that of *S. depressus*, Hope, described at the same time, and even an individual of the same sex (♀).

Indeed the respective descriptions indicate no difference and a suspicious similarity of terms is only partly avoided by a different arrangement of phrases. Although the type cannot be certainly identified, *S. Adelaidæ*, Hope, appears to be also the same species. The form of the front tarsus of the male appears to be the only means of distinguishing *Asemantus* from *Semanopterus*, for the first hind tarsal joint, also mentioned by Mr. Blackburn, is of quite typical form. Except for very strong reasons it is certainly objectionable to found genera upon characters only present in one sex and I am not able to recognise this genus.

Another Australian Dynastid, the *Scarabæus barbarossa*, Fabricius, has never been assigned its proper systematic position, but has been catalogued provisionally under the name of *Oryctes*, like other unplaced species, although it is quite unlike the members of that genus. It has most affinity with the true *Scapanes*, with which it agrees in the absence of propygidial stridulating apparatus, in the long slender tarsi and very spinose middle and hind tibiæ. Although it would not do violence to any essential character of that genus to include it, its very different outward form, the almost complete absence of sexual dimorphism, together with differences in the structure of the legs, maxillæ, etc., render it necessary to form for it a genus, which may be defined as follows:—

HAPLOSCAPANES, n. gen.

Form rather broadly oval, with recurved lateral margins to the pronotum and elytra. Clypeus tapering, bicuspidate at the apex. Mandibles nearly straight at the sides and blunt and prominent at the tips. Maxillæ slender, blunt at the end and without teeth. Labium rather long, regularly narrowing to the points of insertion of the palpi and slightly widening beyond. All the palpi long and slender. Front femora scarcely toothed at the front margin. Front tibiæ armed with three very acute teeth; middle and hind tibiæ produced apically into very long acute spines. All the tarsi long and slender.

♂. Head armed with a short, but slender and acute, horn.

♀. Head armed with a conical tubercle.

There appears to be only a single species, which is common in the Northern territories of South Australia and Queensland. The original Fabrician specimens, now

in the British Museum, are a male and female of very large size. The larva was described by Mr. Blackburn in 1899 (Trans. Roy. Soc. S. Australia, xxiii, p. 27).

The genus *Scapanes* is represented by two very similar species, of which the differences were first pointed out by Macleay (Proc. Linn. Soc., New S. Wales, 1884, p. 703), who determined the shorter and more coarsely punctured form as *S. australis*, Boisd., while to the other he gave the name of *S. politus*. The latter, however, is undoubtedly *S. Menalcas*, Lap., and in all probability is the true *S. australis*, Boisd., also, as considered by the compilers of the Munich Catalogue. I have not discovered the whereabouts of Boisduval's type, which is not in the Paris Museum, but it is this species which was named *S. australis* in Laferté's collection, which comprised Dejean's, etc., and it was taken by Wallace at Dorey, the locality of the type. The shorter species (Macleay's *S. australis*) has recently been named by Herr Sternberg *Scapanes grossepunctatus*, and if I am right the synonymy of the two is as follows:—

S. australis, Boisd., Voyage de l'Astrolabe, Col., p. 158, Pl. IX, fig. 4.
Menalcas, Lap., Hist. Nat., II, p. 114.
politus, Macl., Proc. Linn. Soc. New S. Wales, 1884, p. 703.
S. grossepunctatus, Sternb., Stett. Ent. Zeit., 1908, p. 6.
australis, Macl. (nec Boisd.) *l. c.*

A male specimen of the second species from New Hanover in our collection, which measures 57 mm. in length to the end of the clypeus, has the puncturation of the elytra very sharp and coarse, the cephalic horn rather dilated laterally from the base to the anteapical tooth and the thoracic horns as long as in the best-developed males of *S. australis*, Boisd., but much farther apart. As I have no doubt this represents a local race I call it

S. grossepunctatus, var. *dilatiecornis*.

The following new genus (also Australian) is peculiar for a close resemblance to the Rutelid genus *Anomala* (which, curiously, is indigenous to every great division of the globe except Australia).

ANOMALOMORPHA, n. gen.

Form broadly oval, rather depressed, with the legs slender, the

front tibiæ tridentate, the middle and hind tibiæ truncate at the end, but not dilated, and the tarsal joints equal and slender. Mandibles very small, concealed by the clypeus, rounded at the front and sides, and without teeth. Maxillæ without teeth, the terminal (outer) lobe blunt and ciliated. Mentum long and tapering, bidentate in front. Last joint of all the palpi long and slender. Clypeus very short, with the front margin straight and reflexed. Head and thorax entirely unarmed in both sexes. Prosternum with a slender, sharply-pointed post-coxal process.

♂. The clypeus is a very little shorter, the front tibiæ less strongly toothed, all the tarsi much longer and the abdomen reduced and contracted.

The National collection possesses a number of males belonging to three species, but only a single female, which sex is evidently much rarer than the other. It is an interesting and isolated genus, exhibiting several features foreign to the Dynastidæ in general. The elongation of the tarsi of the male in other genera is a concomitant of the fullest development of armature on head and thorax, whereas genera in which such armature is absent are usually characterised by the opposite condition of contraction of the male tarsi.

Anomalomorpha anthracina, sp. n.

Nigra, nitida, corpore subtus, pedibus antennisque testaceis, capite crebre punctato, clypeo brevi, antice recto, linea frontali vix elevata angulata ; prothorace minute haud crebre punctato, lateribus marginatis, regulariter et fortiter arcuatis ; scutello rugose punctato ; elytris profunde punctato-striatis, lateribus grosse irregulariter punctatis, marginibus lateralibus reflexis, apicalibus fere rectis, angulis sat acutis ; pygidio minute haud dense punctato.

Long. 18–20 mm. Lat. max. 10–11 mm.

Hab. QUEENSLAND : Moreton Bay.

There are two males and a female of this in the British Museum. It is shining black with reddish-yellow legs and underside, broadly oval and not very strongly convex. The head is strongly punctured, the prothorax finely, and the elytra are very coarsely and deeply punctate-striate.

Anomalomorpha geotrupina, sp. n.

Robusta, nigra, nitida, corpore subtus pedibus antennisque rufo-

testaceis, capite postice fortiter punctato, clypeo parum punctato, valde excavato, margine fere rotundato, linea frontali vix angulata elevata; prothorace brevi, sat minute punctato, late marginato; scutello rugose punctato; elytris grosse punctato-striatis, lateribus parcissime punctatis, angulis suturalibus rectis; pygidio leviter punctato, angulis lateralibus rectis.

Long. 18 mm. Lat. max. 11·5 mm.

Hab. QUEENSLAND.

I have seen only a single (male) specimen. It closely resembles *A. anthracina*, but the clypeus is more deeply excavated, a little longer and more rounded in front and less strongly punctured. The prothorax is a little shorter and more broadly margined, the elytra are more meagrely punctured at the sides and the pygidium is more distinctly and uniformly punctured.

Anomalomorpha flavipes, sp. n.

Rufo-picea, corpore subtus pedibus antennisque flavidis; capite fere rugose punctato, clypeo lato, margine late reflexo; prothorace subtiliter punctato, lateribus regulariter arcuatis, marginatis, antice paulo approximatis; scutello parce sat grosse punctato; elytris profunde punctato-striatis, lateribus modice confuse punctatis, marginibus lateralibus arcuatis, reflexis, posticis arcuatis, angulis haud acutis; pygidio basi minute sat crebre, apice parcissime, punctato.

Long. 15–16 mm. Lat. max. 9 mm.

Hab. QUEENSLAND: Rockhampton, Mackenzie River.

We possess five male specimens of this species, which is also very nearly related to the *A. anthracina*, but rather smaller, less black above, and paler upon the underside and legs. The form and sculpture are almost the same, but the prothorax is a little longer and more tapering in front and the scutellum is shining and decorated only with a few large punctures. The apical margins of the elytra are more rounded and the angles less sharp.

A genus *Blabephorus* was founded by Fairmaire in 1898 upon female specimens from Sumatra and Labuan. The description is not only entirely insufficient but rather misleading, and I am indebted to M. Lesne, of the Paris Museum, for kindly making comparisons with the type specimen which have established its identity with a common and widely distributed insect whose long anony-

mity shows the remarkable neglect from which this group has suffered. It is a singular and interesting form which presents a curious resemblance to the genus *Phyllognathus* and supplies a link between the *Heteronychus* group of genera in which the prosternum has a columnar vertical process behind the front coxæ and the *Oryctes* group in which there is no prosternal process. In *Blabephorus* there is a large tumid elevation. *B. pinguis*, Fairm., is chestnut-coloured, rather broad in form, with the thorax more or less excavated in both sexes, and without stridulating apparatus on the propygidium. The front tibiæ are sharply quadridentate, the middle and hind ones strongly carinate outside and digitate at the end. The mandibles are largely exposed, acute in front and roundly dilated at the sides. The maxillæ are armed with three sharp lateral teeth and the mentum is rather broad. The male has a slender, strongly recurved horn, the thoracic excavation is very large and deep and each lateral edge drawn into a point, and the front tarsi and claws are not thickened.

This, the only known species of the genus, is found in North and South India, Burma, the Malay Peninsula, Borneo, Labuan and Sumatra.

Trichogomphus mongol, sp. n.

Niger, nitidus, elongatus, sat parallelus, capite antice bicuspidato; prothorace postice grosse rugoso; elytris lævissimis, stria suturali punctisque nonnullis prope margines anticum atque externalem; pygidio basi grosse punctato atque rufo-hirto:

♂, capite cornu curvato simplici postice compresso armato; prothorace subquadrato, angulis posticis valde obtusis, postice lobato, late elevato, parte elevata antice breviter bituberculata, subtus distincte excavata, tuberculis duobus etiam ante medium lateralibus.

Long. 33–47 mm. Lat. max. 18–25 mm.

Hab. China: Hong Kong, Da-laen-saen; Cambodia: Laos; Burma: Catcin Cauri.

This species was mistaken, both by Burmeister and Fairmaire, for *T. Martabani*, Guér., and the latter under that impression redescribed that species by the name of *T. tonkineus*. It is probable that he relied upon Burmeister's description for the identification of Guérin's species, since the original description and figure leave no

possibility of mistake when the two forms are seen together. They are extremely similar, but distinguishable at once by the strongly punctured elytra of *T. Martabani*, which has two double series of punctured striæ, with similarly punctured interstices, whereas in the new species these are only impressed unpunctured lines, except at the extreme base. The posterior angles of the prothorax are also more obtuse in the male of *T. mongol*, and in well-developed specimens the posterior elevation is more hollowed out in front, the sides being sharply carinate. The average size is distinctly less.

T. mongol appears to have a much wider area of distribution than *T. Martabani*, the latter ranging westward, while the former ranges eastward, from Burma.

Trichogomphus acuticollis, sp. n.

T. mongoli valde affinis et similiter sculpturatus, sed elytris ad margines extremos laterales distincte striato-punctatis, prothoracis lateribus arcuatis antice productis, angulis anticis acutis, latitudine maximo fere ante medium :

♂, *T. mongoli* similiter armato, sed prothoracis elevatione postica vix bicuspidata, fere acuminata.

Long. 38–45 mm. Lat. max. 20–24 mm.

Hab. Tenasserim : Dawnat Range, 1,500 ft.

Two male specimens of this were collected and presented to the Museum by the late Lord Dormer. It very closely resembles the two species just referred to. It has the smooth elytra of *T. mongol*, but in addition to similar well-punctured areas at the base and apex of each there are two or three lines of punctures at the extreme lateral margin, which are scarcely visible in that species. The principal difference, however, is in the shape of the prothorax, which has not at all the quadrate form which is so marked a feature of *T. Martabani* and *T. mongol*, but has the lateral margins produced in front, making a forward-directed angle. The sides are more regularly curved behind and the widest part of the prothorax is at the middle instead of behind it. The scutellum is very scantily punctured.

These differences will probably serve to distinguish both sexes, but I have not seen the female. In the well-developed male the prothorax is very strongly lobed

behind and elevated into a hump, but this is not broadly forked in front, but bluntly pointed, the point showing only a trace of bifurcation. In an undeveloped male the armature is reduced to a condition almost indistinguishable from that of similar examples of *T. mongol.*

Pachyoryctes, n. gen.

Form very robust. Clypeus tapering and bidentate at the end. Mandibles very prominent, blunt in front and sinuated at the lateral margins. Maxillæ stout, broad at the extremity, where they are armed with a series of about 8 minute teeth; palpi moderately long, with the 1st joint slender, the 2nd and 3rd inflated and the 4th long. Mentum thick and rather broad: labial palpi with the last joint large and the preceding ones very small. Front tibia strongly and almost equally tridentate, middle and hind tibiæ strongly spinose at the extremities. Tarsi moderately long and slender, with the first similar to the succeeding joints. Prosternal process broad, not long. Propygidium without stridulating surface.

♂. Head armed with a long, transversely flattened, strongly curved horn. Prothorax strongly retuse in front. Legs similar to those of ♀.

♀. Head armed with a blunt tubercle. Prothorax strongly punctured.

Pachyoryctes solidus, sp. n.

Rufo-piceus, robustus, subtus parce rufo-pilosus; clypeo bidentato; prothoracis lateribus arcuatis, angulis anticis acutis; scutello rugoso, apice obtuso; elytris sparse minute punctulatis, punctorum serie irregulari juxta-suturali; propygidio pygidioque crebre fortiter punctatis:

♂, capite cornu longo, fortiter recurvato, postice planato, armato; prothorace sparse punctato, antice retuso, postice sat distanter bituberculato:

♀, capite rugoso, medio tuberculato; prothorace antice rugoso, postice grosse punctato.

Long. 40–48 mm. Lat. max. 23–26 mm.

Hab. Burma: Carin Cheba, 2,700–3,300 ft.

Two males and a female were collected by Fea. They are chestnut-black, rather smooth but not very shining, with minute scattered punctures above and scanty reddish hairs upon the sternum, sides of the abdomen and legs.

♂. The body is very robust and convex. The head is triangular and sparingly punctured and carries a long strongly recurved horn, the posterior face of which is flattened and slightly excavated. The pronotum is minutely and sparsely punctured, strongly curved at the sides, with the front angles prominent and acute. The prothorax, except at the posterior and lateral borders, is retuse, nearly flat, and very shining, with some large punctures before and behind the posterior margin of the flattened part. This margin is slightly interrupted and depressed in the middle and elevated at each side into a more or less sharp tooth. The scutellum is rugose, short and very bluntly angulated. The elytra have a minute scattered puncturation and a single line of larger punctures upon each side of the suture. The apical margins are more thickly, and the pygidium and propygidium strongly and closely punctured.

♀. A little narrower and less convex. The head is very coarsely and rugosely punctured and armed with a slight tubercle. The prothorax is coarsely punctured, the punctures being distinct behind and confluent and rugose in front, and the front angles are less prominent than in the male. The scutellum is rather more pointed and the elytra a little longer.

The male has the appearance of a stout and broad *Oryctes*, while the female greatly resembles that of a *Trichogomphus*, but the structure of the hind tarsi, the maxillæ, the horn of the male, etc., show it to have a truer relationship with the *Chalcosoma* group, although the absence of any elongation of the legs of the male forms an important distinction from *Chalcosoma*, *Eupatorus*, etc.

Two species of *Eupatorus* are enumerated in the Munich Catalogue, but they are in reality only colour varieties of a single species *E. Hardwickei*, Hope. The elytra of this vary in colour from light mahogany to black, but the outer margin nearly always remains pale, and the variety which is entirely black except this pale elytral border constitutes the var. *Cantori*. Another species occurs in Burma, Siam and Tonkin and appears to be still undescribed. Herr Nonfried has described a specimen from Kashmir by the name of *Eupatorus Atkinsoni*, but the chief difference which he finds between it and *E. Hardwickei* is in the greater breadth of the part which he calls in his Latin diagnosis the quadridentate labrum and later on the galea,

and which really consists of the bidentate clypeus together with the tips of the mandibles. As the extent to which the mandibles of different individuals are opened is not regarded by competent entomologists as a character of weight in the separation of species, and as application to the author for assistance in resolving the matter has not been successful, the name *E. Atkinsoni* must be regarded as a synonym of *E. Hardwickei*, Hope. The locality seems to preclude its reference to the species which is here described.

Eupatorus gracilicornis, n. sp.

Crassus, elongatus, niger, elytris flavis, sutura, marginibusque externis angustissime nigris:

♂, nitidus, capite longissime et gracilissime cornuto, prothorace sat longe 4-cornuto, cornubus omnibus fere æqualibus, curvatis, duobus lateralibus prope angulum medianum, duobusque dorsalibus:

♀, inermis, prothorace creberrime punctato, lateraliter rugoso, elytris subtiliter coriaceis, punctatis, postice paulo pubescentibus.

Long. 48–70 mm. Lat. max. 25–35 mm.

Hab. Assam, Jaintia Hills; Burma, Shan States; Siam, Chengmai; Tonkin, Dong-Van.

Black, with the elytra straw-coloured except at the sutural and extreme outer margins, which are dark. The form and colouring are almost those of *E. Hardwickei*, but the body is rather more elongate, and the elytra are normally lighter in colour and without a paler border.

♂. The armature is similar to that of *E. Hardwickei*, but all the horns are more slender, that of the head in the largest specimens reaching a length of 40 mm. The anterior thoracic horns are much longer, being fully as long as the posterior pair, strongly curved, and arising farther back than in the other species, giving the prothorax the appearance of being more produced in front.

♀. This is extremely like that of the older species, but besides the greater elongation and paler elytra, the latter are minutely pubescent only at the posterior part and the pronotum is more strongly sculptured and closely rugose at the sides.

The curvature and direction of the horns of the male vary very much. The cephalic horn is sometimes very strongly and sometimes only slightly curved backwards

and the anterior thoracic horns generally diverge considerably but sometimes slightly converge. In small specimens the dorsal horns may completely disappear.

I have seen a considerable number of examples, most of them males.

Eupatorus birmanicus.

Convexus, sat longe ovatus, piceus, opacus, coriaceus, corpore subtus parcissime rufo-hirto:

♂, clypeo acute bidentato, cornu gracili acuto, fortiter recurvato, armato; prothorace vix punctato, lateribus parum arcuatis, postice fere parallelis, antice valde approximatis, angulis anticis acutis, utrinque pone angulos anticos acute productis cornubusque duobus dorsalibus ante marginem posticam spatuliformibus approximatis retro directis, pedum anticorum femoribus vix dentatis, tibiis paulo elongatis, dentibus acutis transversis denteque infero verticali, tarsis vix elongatis.

Long. 45–48 mm. Lat. max. 25 mm.

Hab. Burma: Moulmein, Mergui.

The colour is a very dark chestnut, approaching black, and the form convex and moderately elongate. The upper surface is coriaceous and scarcely shining, the scutellum and elytra quite opaque and the pygidium and propygidium finely rugose and minutely setose. The lower surface is very scantily furnished with tawny hairs.

♂. The head is bidentate in front and bears a long slender and sharply-pointed horn, strongly curving backwards in the basal half and afterwards almost straight. The prothorax is about as long as it is broad, with the sides nearly parallel behind and strongly tapering in front, the margins produced into a sharp point on each side just behind the front angle and the dorsal part bearing a pair of spatulate horns placed close together behind the middle. These are convex on their posterior face and concave on the anterior, they slope backwards and their tips almost meet. The legs are not long, but the front tibiæ are slightly elongate and bear three nearly equal acute teeth set at right angles and a vertical tooth on the lower surface at the extremity. The front femur has an irregularly rounded laminar projection near the middle of the anterior margin.

A second ♂ specimen of low development shows the

remarkable tendency to dimorphism seen in males of other genera of the group. The size is little less than that of the type specimen, but the cephalic horn is only a third of the length and bifurcated at the end, and the thoracic horns are represented by a pair of nodular processes occupying the same position, but showing no indication of the very peculiar form assumed in its fuller development.

I have not seen the female.

This insect is exceedingly like *Alcidosoma siamense*, Lap., in all respects except the position, shape and direction of the thoracic horns. It is a little more elongate, the margins of the prothorax are rather straighter and more parallel behind and its surface more smooth and shining, and the pygidium is more closely rugose.

In making the genus *Alcidosoma*, Laporte declared that it was not in his opinion really entitled to generic separation from *Chalcosoma*, but it is still more closely related to *Eupatorus* and males of *A. siamense* in a certain stage of development are almost identical in form to *Eupatorus Hardwickei*, Hope, differing only in the fine sculpture of the surface of the body. They agree also in the broad multidentate outer lobe of the maxilla, which is very different from the acuminate form of that of *Chalcosoma*, in which the mentum is also much longer and narrower. *C. Beccarii*, Gestro, is an intermediate having in my opinion more points of affinity with *Eupatorus* than with *Chalcosoma*. The mentum is of the same form and the maxillæ are blunt at the end, but with a sharp tooth beneath, which is not found in the other species. The male does not possess the anterior thoracic processes of *Eupatorus*, but the small importance of the sexual armature is shown by the curiously different forms assumed in *E. siamensis* and *E. birmanicus*, which are so closely alike in all other respects. The discovery of other forms may yet bridge the interval by which *Chalcosoma* is divided from *Eupatorus*, but for the present the form of the mentum and maxillæ, together with the great elongation of the legs in the male, serves to distinguish *C. Atlas*, L. (=*Phidias*, Bl.) and *C. Mollenkampi*, Kolbe, while I refer to *Eupatorus* the following species:—*E. Hardwickei*, Hope (with var. *Cantori*, Hope), *gracilicornis*, Arrow, *siamensis*, Lap., *birmanicus*, Arrow, *Beccarii*, Gestro, and the following Australian species, which, although in many respects the most divergent of all, has considerable similarity to *E. Beccarii*.

Eupatorus australicus, n. sp.

Nigro-piceus, robustus, sat late ovatus, clypeo rugoso, obtuse acuminato; prothoracis lateribus rugose punctatis, marginibus a basi ad apicem valde arcuatim convergentibus; scutello grosse punctato; elytris subseriatim punctatis, punctis irregularibus sat crebre interspersis; pygidio dense punctato et breviter setoso; pedum anticorum femoribus inermibus, tibiis oblique 3-dentatis:

♂, capite cornu compresso recurvato intus minute dentato armato; prothoracis dorso utrinque recte et acute antrorsum producto; tibiis anticis leviter elongatis, dentibus haud validis:

♀, capite minute sat acute tuberculato; prothorace fortius rugoso-punctato, medio leviter canaliculato, postice utrinque lævi.

Long. 41–53 mm. Lat. max. 24–30 mm.

Hab. Queensland.

The colour is a very deep brown and the form oval and compact, well punctured but moderately shining. The clypeus is bluntly acuminate, and not distinctly bifid. The mandibles are rather broad and leaf-like, strongly incurved at the sides and not straight as usual. The maxillary lobe is slender and without teeth.

♂. The head is armed with a compressed horn, not very long or slender, with its anterior face slightly dilated and the posterior part rather compressed, and bearing a tooth beyond the middle except in poorly-developed specimens. The prothorax bears a stout and sharply-pointed but not very long horizontal horn on each side of its dorsal part, and the median and posterior part is smooth and the sides rugosely punctured.

♀. The head bears a slight sharp tubercle and the prothorax is feebly channelled along the middle where, as well as at the front and sides, it is rugosely punctured.

Lycomedes Ohausi, sp. n.

Sericeus, rufo-olivaceus, variabile pallido-nubilatus, prothoracis lateribus antice acute angulatis, post medium geniculatis; elytris deplanatis, sat vage punctatis, lateribus ad medium fere parallelis, deinde conjunctim semicircularibus:

♂, clypeo recto, angulis lateraliter acute productis, cornu gracili, apice acute bifido; prothoracis cornu lato clavato, antice profunde excavato, postice leviter impresso:

♀, inarmato, prothorace grosse et crebre punctato, haud sericeo.

Long. 26–31 mm. Lat. max. 18 mm.

Hab. Ecuador, Rio Casanga (2,500 m.).

A series of examples were taken by a correspondent of Dr. Fr. Ohaus upon a flowering "*Schling*" plant.

This species is very closely related to *L. Burmeisteri*, Wat., from which it differs markedly in the armature of well-developed males, but in minute particulars only in females and undeveloped males. The general form is a little less broad and flattened, the elytra not widening at all behind the middle as in the other species. The front angles of the prothorax are more prominent and the lateral angulations rather less prominent and situated a little further back. This applies to all specimens of both sexes.

In the male the prothoracic horn, which in *L. Burmeisteri* is broad at its base and somewhat narrows to its extremity, is club-shaped, being constricted near the base and swelling out at the tip, where the sides bend over, producing the appearance of a bulb when seen from behind. It is less broadly and deeply impressed at the base behind than in the allied species. The clypeus is more angulated on each side than in *L. Burmeisteri*, but the cephalic horn is not different. In small males with only a rudimentary thoracic horn the club-shaped form is not seen.

I have seen 16 examples, 11 of which are males.

In a recent paper (Ann. and Mag. Nat. Hist. (7), XIX, 1907, p. 357) I have suggested the transference of the genus *Oryctomorphus* from the Dynastidæ to the Rutelidæ. I consider it desirable to take the same course with two other aberrant genera hitherto regarded as belonging to the Dynastidæ, viz., *Peltonotus* and *Pachylus*. These are widely different one from the other, but agree in having a well-developed externally-visible labrum and unequal claws upon all the feet, and in Pachylus one claw of each pair is toothed. These are features characteristic of the Rutelidæ, but the genera are very aberrant and must occupy an isolated position in any family to which they are referred.

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XVI. *On certain* Nycteribiidæ, *with descriptions of two new species from Formosa.*

By Hugh Scott, B.A. (Cantab.). *Communicated by* Dr. David Sharp, M.A., F.R.S.

[Read June 3, 1908.]

Plate XVIII.

In dealing with these species of Nycteribiidæ, I wish to express my thanks to Dr. P. Speiser, the well-known authority on this family of insects, for kindly examining specimens of the forms here described, and for giving me much guidance. Of the first 3 species—*Penicillidia jenynsi*, *Nycteribia insolita* and *N. sauteri*—all the specimens which I have seen were sent from Formosa, together with the bats from which they had been taken. Both parasites and hosts are in the Cambridge University Museum of Zoology, which is indebted for them to the enterprising naturalist, Herr H. Sauter. The four bats on which the Nycteribiids were found belong to a very widely distributed form, *Miniopterus schreibersii*, Natterer.* The labels with all the specimens record the same date and locality, Tainau, Formosa, 7, X, 1906. The bats bore labels with the numbers 5080, 5081, 5083, 5085; the Nycteribiids were sent in spirit in 4 tubes, with 4 labels bearing corresponding numbers. Thus all the parasites contained in a single tube were evidently found on a single bat-individual.

An interesting fact can then be noted with regard to the natural history of the Nycteribiids. It is that 3 distinct species of Nycteribiidæ, belonging to 2 genera, were found on four individuals of the same species of bat: while in three cases, 2 distinct genera of the parasites were found on a single individual of the host. Thus :—

* One of these specimens was seen several months ago, at the British Museum of Natural History, by Dr. K. Andersen of Copenhagen. Dr. Andersen stated that it was one of the forms at present known as *M. schreibersii*, but that that species will probably have to be divided into several species.

On the bat numbered 5080 were found *Penicillidia jenynsi* 1 ♀, and *Nycteribia sauteri* 1 ♂ and 1 ♀.
On the bat numbered 5081 were found *P. jenynsi* 1 ♂ and 1 ♀, and *N. insolita* 1 ♂.
On the bat numbered 5083 were found *P jenynsi* 1 ♀ and 1 larva, and *N. insolita* 2 ♀ ♀.
On the bat numbered 5085, 2 ♀ ♀ *N. insolita*.

PENICILLIDIA, Kolenati.

Penicillidia jenynsi, Westwood.

Nycteribia jenynsi, Westw., Tr. Zool. Soc. London, I, 1835, p. 291; Kolenati, Horæ Soc. ent. Ross. II, 1863, p. 88.
Penicillidia jenynsi (Westw.), Speiser, Arch. Naturg. 67 (1) 1901, p. 38.

1 ♂ and 3 ♀♀ (and 1 larva) sent from Tainau, Formosa; found on *Miniopterus schreibersii* (H. Sauter). Type ♀ and the other specimens in the Cambridge Museum. The ♀ is here described for the first time, only the ♂ having been known hitherto.

Dr. P. Speiser informs me, after examining some of the specimens, that they belong to the species regarded by him as *P. jenynsi*, and described by him (*l. c.*) under that name. As Westwood's type of *P. jenynsi* unfortunately cannot be found, it has not been possible to make a comparison in order to ascertain whether the form under consideration is certainly identical with the *P. jenynsi* of Westwood.

The colour of the firmly chitinised parts is rather pale yellowish-brown. Both sexes agree with Speiser's description in the following particulars: length about 2·5 mm.; head with numerous strong bristles between the eyes; the bristles continue down the margins of, but are absent from the surface of, the cheeks; maxillary palps with numerous strong bristles, the terminal ones very long; under surface of thorax * markedly curved in the longitudinal direction, with a dark middle line somewhat impressed at the ends. The legs are as described by Speiser.

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* The curvature of the surface renders it hard to estimate correctly the proportion of length to breadth. In the table given by Speiser (*op. cit.*, p. 66) *P. jenynsi* is placed in a section of the genus in which the thorax is longer than broad. In the specimens from Formosa the breadth appears at any rate equal to, if not slightly greater than, the length.

Abdomen of the ♂. (Fig. 1 dorsal, Fig. 2 ventral view.)—The abdomen of the specimen from Formosa disagrees in some small details with Speiser's description. Tergites 2, 3 and 4 have short bristles on their surface, in addition to the long bristles on their hind margins. The anal segment has scanty bristles on its surface, as well as at its hind corners. Of the sternites, only the basal one has fine bristles on its surface. Sternites 2, 3 and 4 are quite bald, except for the fine bristles along their hind margins. As in the ♀, the basal sternite bears some long bristles rather far apart, just in front of the ctenidium.

Abdomen of the ♀. (Fig. 3 dorsal, Fig. 4 ventral view.)—The distinguishing characters of the ♀, now described for the first time, lie in the form of the abdomen.

Basal tergite firmly chitinised, with conspicuously rounded hind margin ; quite bald, except for 2 groups of 4-6 strong, moderately long bristles on the hind margin, one group immediately on either side of the middle line. *Tergite* 2 rather long, firmly chitinised, with hind border much less curved ; the surface quite bald, hind margin set with strong bristles of varying length, at the sides moderately long, in the middle very long but not very close. *Tergite* 3 consisting anteriorly of soft whitish, extensible skin, quite bald; posteriorly of a yellowish chitinised portion more than four times as broad as long (Fig. 3*a*), its surface bald or with few short bristles, its hind margin bearing strong bristles of varying and alternating lengths, some very long. *Anal segment* firmly chitinised (except right at the base), truncated-conical, its length about equal to its breadth at the base, breadth at apex less than ½ that at base ; base bald, followed by area bearing strong outstanding moderately long bristles rather far apart; posterior part of segment quite bald ; hind margin bearing several rather short bristles, with a long bristle at either angle.

Basal sternite large, with scanty short fine bristles on the surface except in the median-basal part, and with a row of long bristles a little before the hind margin ; ctenidium not strongly developed, teeth in the middle rather far apart. Next follows a large area of soft whitish extensible skin, with numerous rather short strong bristles, and 8 long ones arranged in a curved transverse row (Fig. 4*a*). Beyond this area are two oval, rather convex, chitinous plates (Fig. 4*b*), nearly touching at the middle line ; their basal portions bald, posterior portions with a few short strong bristles, hind margins with a number of moderately and very long strong bristles. Immediately behind these plates is a short chitinous segment (Fig. 4*c*), extending across the body, its hind margin bearing short bristles medially, very long strong bristles on either side. Behind this, just in front of the genital opening, is a chitinous plate (Fig. 5), as long as or longer

than broad, with its hind margin deeply and rather widely emarginate; its base is bald, the rest of its surface bears strong, but not very long bristles; those at its hind angles are longer. At the base of this plate is a dense group of strong dark spines on either side of the body. Ventral surface of anal segment bearing some long bristles medially.

Dr. Speiser has recently described* a new species, *P. leptothrinax*, from Madagascar. This is closely allied to *P. jenynsi*. Judging from Speiser's description, the ♂♂ of the two species are very much alike. Speiser states that the ♂ *P. leptothrinax* is distinguished "durch die wesentlich dichter und auch auf der Fläche beborsteten Tergitplatten." In the ♂ *P. jenynsi* from Formosa, however, as stated above tergites 2–4 bear bristles on their surfaces as well as their hind margins. It may also be pointed out that the row of long bristles just in front of the abdominal ctenidium in both sexes, is present in the Formosan specimens of *P. jenynsi* as well as *P. leptothrinax*.

However much alike the males may be, there are distinct differences in the females of the two species. The basal tergite of *P. jenynsi* ♀ is of very distinctive form. Instead of the two pairs of chitinous elevations on the dorsal surface of the abdomen in *P. leptothrinax* ♂, *P. jenynsi* has the single transverse chitinous piece (Fig. 3*a*). Ventrally, the one pair of well-defined chitinous plates (Fig. 4*b*) followed by the chitinous segment (Fig. 4*c*) are distinctive and characteristic of *P. jenynsi*. In the conspicuously emarginate plate before the genital aperture (Fig. 5), *P. jenynsi* ♀ seems to approach somewhat to *P. cuxesta*, Speiser.

Larva. (Figs. 6, 7, 8.)—One ♀ specimen was found to be carrying a larva, which projected behind it; all the body of the larva was outside that of the adult, except a small anterior portion which was still within the widely-opened genital aperture. The larva, when completely freed from the adult, was found to have not the simple ellipsoidal form of previously described Nycteribiid larvæ, but the form shown in Fig. 6, the small anterior portion which was still within the body of the mother being marked off from the rest by a sharp constriction. The anterior surface of this constricted part is somewhat flattened in a nearly vertical direction

* Voeltzkow, Reise in Ostafrika in den Jahren 1903–1905, II, 1908, p. 199. (Stuttgart).

(Fig. 7). In the upper part of this anterior sloping surface is the mouth (Fig. 8*c*), which in this specimen was covered by a brownish mass (figs. 7*a*, 8*a*), apparently of cuticular substance, attached to the surface of the larva by its upper edge as by a hinge. In Fig. 8*a* it is shown lifted up to expose the mouth aperture. On the ventral surface of this anterior constricted part of the larva, a little behind its front edge, there are in the middle two small flattened pieces with rounded apices (Figs. 7*b*, 8*b*), close together and projecting downwards. The skin of the larva bears some fine longitudinal creases in the region of the constriction.

It is quite uncertain whether the anterior constriction of the larva is merely accidental or not. There is the possibility that the larva was leaving the genital aperture of the adult at the time when the latter was captured, and that at death the abdomen of the adult contracted on the larva, constricting it forcibly. On the other hand, the constriction is extremely regular in its formation, as though it might be natural to the larva. One may quote an observation recorded in an as yet unpublished paper by Mr. F. Muir, who investigated the anatomy of certain Nycteribiids in the island of Larat (Timorlaut Islands). He states that the larvæ had "a constriction at the anterior end cutting off a small mass"; he speaks of the mouth as being on this small mass, but says that no signs of mouth-organs were visible. I understand from Mr. Muir's paper that this refers to larvæ which he found by dissection still in the uteri of the adults. The brownish mass closing the mouth aperture in my specimen is probably no more than a mass of cast skin. But the two small structures (Figs. 7*b*, 8*b*) appear too regular in form to be in any way accidental. Were it not that they are placed below, and so far away from, the mouth, one might consider them to be rudimentary mouth-organs such as have been described by Leuchart * and Pratt † in the larva of *Melophagus ovinus*. Such mouth-parts have not been seen in Nycteribiid larvæ ‡ previously described.

For the rest, the larva of *P. jenynsi* agrees with the general description of Nycteribiid larvæ given by Speiser. It is yellowish-white (preserved in spirit), slightly flattened dorsoventrally. It has the usual 2 pairs of spiracles

* Abh. Naturf. Ges. Halle IV, 1858, p. 176 and Taf. 3, Figs. 1, 2.
† Arch. Naturg. 59 (1), 1893, pp. 156, 165.
‡ Speiser, Arch. Naturg. 67 (1), 1901, p. 28.

situated dorsally and posteriorly (Fig. 6): one pair, only separated from one another by a distance = 1 to 2 diameters of the spiracle, quite close to the posterior extremity of the body; the other pair, separated from one another by a considerable distance, and about $\frac{1}{4}$ the length of the body from its hind end. The ventral surface of the larva shows the peculiar configuration mentioned by Speiser (*op. cit.*, p. 27). There is a median area sunk slightly below the level of the surrounding body-surface, with its cuticle much wrinkled and creased longitudinally, the creases continuing in front along the ventral surface of the constricted part of the larva's body. The cuticle of the surrounding body-surface, where it edges on and slightly overhangs the median area, has a different appearance, being marked with fine creases radiating from the edge of that area.

NYCTERIBIA, Latreille.

Subgenus *LISTROPODIA*, Kolenati.

Nycteribia (*Listropodia*) *insolita*, sp. nov.

Pallide flavescens; thorace subtus longiore quam lato; femoribus tibiisque latis; abdominis segmento ventrali basali in medio longitudinaliter impresso.

♂ segmentum anale longum, angustum, postice vix augustatum, apice truncato.

♀ segmentum anale conspicue bilobatum, laminis duabus lateralibus productis, superficie internâ concavis.

Long. corp. 1·5 mm.—1·75 mm.

1 ♂ and 3 ♀♀ sent from Tainau, Formosa (Sauter); found on *Miniopterus schreibersii*. Type ♂, type ♀, and the 2 other ♀ ♀ in the Cambridge Museum.

Head bare, except for a few short bristles in the middle in front, and along the cheek-margins. Maxillary palpi with very long terminal bristles. Thorax dorsally with a curved row of bristles on either side. Thorax ventrally a little longer than broad, rounded in front, with a brownish middle line somewhat impressed at the ends; surface of the thorax bearing the usual short bristles, and on its hind margin 4 long ones, of which the two outer are very long. Femora and tibiæ (Fig. 13) flattened, each about $2\frac{1}{3}$ times as long as its greatest breadth. The femora bare on one surface and bristle-

bearing on the other ; in the anterior pair, the outer posterior surface is bare ; in the middle and posterior pairs the anterior surface is bare. Lower edges of the femora curving up a little abruptly at their distal ends. Tibiæ with bristles on the upper edge, and 3 cross rows of strong dark bristles on the lower edge distally. There are one or two very long outstanding bristles on the lower edge of the femur and the upper edge of the tibia.

Abdomen of the ♂. (Fig. 9.)—Long and narrow. Excluding the anal segment, 5 distinct tergites can be seen, but the basal one is longer, and really consists of two segments partially fused together, the line of division between them being visible in some aspects : I shall, however, consider them as a single tergite, no. 1 (Fig. 9*a*).

This *Tergite* 1 with numerous very short bristles on its surface, rather longer ones on its hind margin. *Tergite* 2 with few bristles on its surface ; with bristles of varying lengths, some fairly long, on its hind margin. *Tergite* 3, 4, 5 bare on the surface, their hind margins set with short stiff spines, alternating with every two or three of which are long bristles, the 4 nearest the middle line being very long. *Anal segment* strikingly long and narrow (about $1\frac{2}{3}$ times as long as broad), not tapering ; the surface in the middle bears a very few scattered short stiff bristles, and there are a few more such bristles, alternating with rather longer ones, on the hind border.

Basal sternite somewhat impressed along the middle line, with not very short bristles on its surface ; ctenidium well developed, the teeth close, shorter in the middle, so that the outline of their apices appears sinuate. *Sternites* 2, 3, 4, without very definite marginal rows of bristles, but with rather scattered strong bristles (some on the surfaces as well as on the margins) mostly of moderate length, some of those at the sides being very long. *Sternite* 4 bears in the middle part of its hind margin, about 4 stiff spines rather far apart. *Claspers* (Fig. 10) long, slender, slightly curved outwards in the distal half, curved in again at the apices, which are dark.

Abdomen of the ♀. (Figs. 11 and 12.)—Rather long and narrow. Excluding the anal segment, 3 dorsal plates (tergites) are distinguishable. *Tergite* 1 (Fig. 11*a*) small, with very short fine bristles on the surface, slightly longer at the hind margin. *Tergite* 2 (Fig. 11*b*) in some specimens bare, in others with very short bristles, on its surface ; hind margin bearing very long fine bristles and some small short spines. Between tergites 2 and 3, an area of whitish extensible skin bearing numerous rather strong short bristles, longer at the hind margin. *Tergite* 3 (Fig. 11*c*) a bare chitinous plate, bearing only 4 very long outstanding bristles far apart, and strong short spines along its hind margin. *Anal segment* composed of two lateral pieces—with

convex outer surfaces, inner surfaces somewhat concave, and apices rounded enclosing a median portion (Fig .11*d*) only about ½ as long as the lateral parts; the latter have a few short bristles on their outer surfaces, longer strong bristles apically; the median part has 2 rather long fine bristles on its hind margin.

Basal sternite as in the ♂.—[Owing to softness and shrinkage it is impossible to estimate correctly the relative lengths of sternites 2, 3 and 4.] *Sternites* 2, 3 soft, short, with long bristles not close on the hind margins, and very short fine bristles on the posterior part of their surfaces. *Sternite* 4 with long bristles on its hind margin, and a few short ones on its surface. *Sternite* 5 is a long chitinous plate (Fig. 12*a*) appearing as if composed of two segments fused; at about ⅓ the length from its base is a transverse row of long and short bristles (marking the limit of one component sternite), and its hind margin also bears long and short bristles; rest of its surface bare. *Anal segment* ventrally appearing rather long and narrow, markedly emarginate in the middle of its hind border, with rounded corners, a median longitudinal impression, and a few bristles distally.

The curiously formed ♀ anal segment of *N. insolita* somewhat resembles that of *N. blasii*, Kolenati, and of *N. pediculariæ*, Latr. (= *N. latreillei*, Leach), in both of which the segment has produced lateral plates. *N. insolita* is distinguished by its smaller size, and by the thorax ventrally being longer than broad; the possession of the long chitinous ventral plate (sternite 5) also is characteristic. The ♂ also resembles *N. blasii* somewhat in having a long anal segment, but differs in the form of the thorax, etc.

Nycteribia (*Listropodia*) *santeri*, sp. nov.

Pallide flavescens; thorace subtus perparum latiore quam longo; femoribus tibiisque parum latis.

♂ segmentum anale supra brevissimum, subtus longius, apice lato.

♀ segmentum dorsale 2 curtum, læve, superficie sine capillis: segmenta ventralia 3 et 4 utrumque laminis duabus perparum elevatis: segmentum anale æque longum ac in basi latum, postice angustatum, subtus utrinque tuberculis duobus obtusis parum elevatis.

Long. corp. circa 1·25 mm.

1 ♂ and 1 ♀ sent from Tainau, Formosa (H. Sauter); found on a single individual of *Miniopterus schreibersii* Type ♂ in the Cambridge Museum. The ♀ was unfor-

tunately lost, but luckily this did not occur till after it had been closely examined, and figured.

Although the femora and tibiæ are not very broad, and the ♂ has a very short anal segment, yet it does not seem possible to place this species in any subgenus but *Listropodia*.

Head with short bristles along the cheek-margins, and with a few at the front margin of the crown : otherwise bare. Thorax dorsally with a curved row of bristles on either side. Thorax ventrally very slightly broader than long, flat, with the portions anterior to the oblique lines sloping upwards somewhat : middle line red-brown, impressed posteriorly, and also slightly anteriorly : surface as usual bearing fine bristles, with some longer ones at the hind margin, of which two are very long. Femora and tibiæ (Fig. 14) not very broad : greatest breadth of femur = only a little over $\frac{1}{3}$ its length ; that of the tibiæ = $\frac{1}{3}$ its length. Femora and tibiæ of the ♀ slightly broader than those of the ♂. Tibiæ with the usual 3 cross-rows of bristles on their lower side distally.

Abdomen of the ♂. (Figs. 15 and 16).—Long and narrow. Excluding the anal segment, 5 dorsal segments (tergites) are visible : the first is really composed of 2, but the small basal one is not very sharply delineated, and is hard to see ; this compound tergite is here reckoned as No. 1 (Fig. 15*a*.) *Tergites* 1, 2, with short bristles over their surfaces, long ones on their hind margins. *Tergite* 3 with a few rather longer bristles on the surface, long bristles on its hind margin. *Tergites* 4, 5 bare on the surface, their hind margins set with short stiff spines, between every 2 or 3 of which are long bristles, 2 near the middle of tergite 5 being very long. *Anal segment* viewed from above remarkably short, only about $\frac{1}{2}$ as long as broad : hind margin not rectilineally truncate, but forming a slightly concave curve : dorsal surface bare, sides and hind angles bearing strong bristles.

Basal sternite without median impression, bearing fine bristles not very close : ctenidium well-developed, its margin scarcely sinuate. Of *sternites* 2, 3, 4, no. 3 is longest ; nos. 2 and 3 have a few short bristles on the surface, no. 4 is almost bare : their hind margins bear bristles of very varying length, not very close, some (especially at the sides) being very long and strong. *Anal segment* ventrally much longer than dorsally, its length nearly = its breadth at the base, its apical breadth = a little over $\frac{1}{2}$ its basal breadth : surface bare, except for two divergent rows of bristles, one on either side, commencing at the edge of the cavity in which the claspers lie, and running outwards and backwards from near the apex of this cavity to the side of the segment. Claspers narrow, rather short, with

apex sharp and not dark, with no marked curve in the horizontal plane, and with bristles (growing shorter towards apex) extending from base almost to extreme apex.

Abdomen of ♀. (Figs. 17 and 18.)—*Basal tergite* small, bearing short bristles on its surface, with no long bristles on its hind margin. *Tergite* 2 (Fig. 17*a*) short, its surface bare, its hind margin set with long bristles. Line of division between tergites 1 and 2 not very definite in all aspects. Beyond tergite 2 an area of soft skin bearing rather short bristles, not close, and some long ones posteriorly. This area terminates in a *chitinous plate* (Fig. 17*b*) nearly twice as broad as long, bare on its surface; its hind margin bears 4 very long bristles set apart, and between each 2 of them are 2 or 3 short dark spines. *Anal segments* short, its basal breadth quite equal to its length; the segment tapers somewhat, but has its apical breadth = more than $\frac{1}{2}$ its basal breadth; surface almost bare, a few moderately long bristles at the hind corners.

Basal sternite as in the ♂. *Sternite* 2 with about 2 irregular rows of short bristles on its surface, its hind margin bearing long bristles. *Sternites* 3, 4 each bearing a pair of slightly elevated chitinous pieces (Fig. 18*a*) separated by a small interval at the middle line: hind margins of these pieces bearing long bristles; and those of sternite 3 also bearing short bristles on the surface. *Anal segment* ventrally showing 2 pairs of blunt rounded lateral elevations, which bear moderately long bristles: also some short bristles on the surface of the segment near its base, and some moderately long ones at its hind border.

In the shortness of the anal segment in the ♂, this species resembles *N. stylidiopsis*, Speiser; * but the ♂ anal segment of *N. sauteri* is dorsally even shorter than that of *N. stylidiopsis*. The ♀♀ of the two species differ in the form of the anal segment and in other respects. *N. stylidiopsis* also has the thorax longer than broad; and *N. sauteri* has the legs only moderately broad.

CYCLOPODIA, Kolenati.

Cyclopodia royleri, Westwood.

Nycteribia royleri, Westw. Tr. Zool. Soc., London, I, 1835, p. 290; Speiser, Arch. Naturg. 67 (1) 1901, pp. 62, 68.

* In Voeltzkow, Reise in Ost-Afrika, 1903–1905, II, 1908, p. 200. (Stuttgart.)

Acting on Dr. Speiser's suggestion, I have examined Westwood's original type of this species. I am indebted to Professor Poulton for lending it from the Oxford Museum.

In general form, and in the possession of long thin legs with 3 distinct rings on the tibiæ, this species is, as conjectured by Dr. Speiser, undoubtedly a *Cyclopodia*. Only in the form of the eyes is it not quite certain whether it agrees with other members of the genus. After close examination I cannot be quite sure whether those organs are composed of only a single ocellus, or of more than one. To all appearance each eye consists of only one ocellus. Should this be so, either the presence of several ocelli can no longer be used as a sure criterion of the genus *Cyclopodia* at all, or the genus must be divided into subgenera characterised by the numbers of the ocelli.

The following particulars as to the type, which is preserved dry, will probably amplify previous descriptions.

♂. Length 2·75 mm. Colour dark brown, legs lighter. Thorax ventrally as broad as long, middle line with a rather deep impression at the hind end. Front coxæ not at all elongate (no longer than hind coxæ), nor thickened. Rest of front legs missing from the specimen, other legs offering no peculiarities.

Abdomen. (Fig. 19.)—The 5 *tergites* all bare on the surface; *the rows of bristles on their hind margins extending right across the abdomen.* Tergites 2 and 3 are long; 4 is shorter; 5 short, only ½ as long as 3. *Anal segment* not long but rather conspicuously tapering; it is almost as long as tergites 4 and 5 together; its length is not quite = its breadth at the base, its breadth at the apex is less than ½ that at the base; surface bare, hind margin with bristles, longer at the sides.—*Basal sternite* with a median longitudinal impression, bare at the base, and with short bristles on the rest of its surface: appearing rather long and narrow, but perhaps the basal part would normally be hid under the thorax. *Sternites* 2, 3 with short bristles on the surface, scanty in 3: with no definite rows of bristles apparent on their hind margins, only a few very small spines laterally in sternite 3. *Sternite* 4 quite bare on the surface, the hind margin having a small ctenidium medially and on either side of this long bristles. *Claspers* long, narrow, and sharp at the apex, which is distant by about ⅓ the length of the anal segment from the hind margin of the segment in front.

"Habitat in India orientali" (Westwood.)

Judging from descriptions in Speiser's article cited above, this species would appear to be quite distinct from any other described species of *Cyclopodia*. The fact that the rows of bristles on the margins of the dorsal segments are continuous across the abdomen, and that the claspers do not reach the hind margin of the penultimate segment, seems to ally it to *C. dubia*, Westw. and *C. minor*, Speiser; but its size is smaller, and its anal segment apparently shorter. The shortness of the front coxæ is a good character; and there is also the point mentioned above about the eyes.

Explanation of Plate XVIII.

[*See Explanation facing the* Plate.]

XVII. *Are* Everes argiades *and* coretas *distinct species?*

By T. A. Chapman, M.D., F.Z.S.

[Read May 18, 1908.]

Plates XIX, XX.

Mr. Tutt asked (Ent. Soc. March 18th, 1908) for further facts bearing on whether *coretas* was or was not a species distinct from *Everes argiades*. Nothwithstanding that Dr. Rebel says they are but one species and that the ancillary appendages of the ♂ are identical, I thought it desirable to investigate this point for myself, and now report the result as having a most important bearing on the question under consideration, and involving also some interesting principles concerning differentiation of species.

The facts concerning the ancillary appendages are, without going into descriptive details, that the two forms have different appendages, the differences are very slight but they are very distinct and very constant, so slight that we can quite understand their being overlooked.

It may be asked, Have such minute differences any value for distinguishing species? In this particular instance they have. In many species one finds much greater differences in these organs even amongst specimens taken at the same time and place. One finds also greater differences between geographical races which we nevertheless agree to belong to one species. Why, then, are these minute differences of weight in this instance? In the first place they are constant as between the two forms; in the second these two forms in no way suggest that they are geographical races. If we found (say) *argiades* in France, Switzerland and Austria, and *coretas* in Spain and Italy, one would at once accept the geographical explanation. But the facts are very different; the two species occur, if not on the same ground, at least within a few miles of each other, from their extreme western distribution at Biarritz or rather Bilbao (*argiades* occur further west in Asturias, but we know little of their Spanish distribution) eastwards to Buda-Pesth, and unquestionably could readily cross, so far as geographical difficulties govern the case.

That the differences between the appendages, slight

though they are, are nevertheless important, is a conclusion that is much strengthened by the fact that those of *Lycæna minimus* differ from them so little, that one would expect them to be declared identical by those who fail to discriminate between *argiades* and *coretas*, yet *minimus* has usually been regarded as belonging to quite a different group of *Lycænæ*.

We discriminate species now, on what we call physiological grounds, and not on morphological. What I take this to mean is that the germ plasma of distinct species is more or less immiscible, of forms of one species it is freely miscible. We hold this view, though as a matter of fact, we cannot apply it in one case in perhaps a thousand; what we do do, is to form an opinion about it (always involving the personal equation) from all the facts we can ascertain, not merely morphology, but habits, distribution and everything else available.

In the case of *coretas*, the somewhat doubtful presumption that it is distinct from *argiades*, is by the evidence of the appendages raised not to certainty, but a long way towards it, since it makes nearly certain, that, though opportunities must frequently occur, the germ plasma of the two forms never mixes. The appendages, slight though the differences are, are quite constant, and no intermediates occur. In the ordinary wing-markings, a good deal of variation occurs in both species, and perhaps no one feature is constant, though I have not as yet been in any serious doubt as to which species a doubtful example belonged to, and where the appendages of a doubtful specimen were examined they always agreed with the conclusion that had been arrived at.

When we come to the American forms *amyntula* and *comyntas*, my material is quite insufficient to say whether there are one, two, or more species in North America. But specimens from Calgary and California have identical appendages which are intermediate between *argiades* and *coretas* but much closer to *coretas* than to *argiades*. Are we to call them one with *coretas*?

I incline to the somewhat paradoxical view, that these American forms are co-specific with both our European ones, although these are "good" species as against each other.

A Central American *argiades* is by its appendages again a distinct species though there may be intermediates connecting this with *amyntula*. In the absence, however, of

evidence to the contrary, I believe the differences in the appendages to be rather beyond mere geographical variation. As regards *parrhasius* and *dipora*, I am not prepared to give any fully considered opinion. My material and information are much too scanty. The original descriptions of *parrhasius* and certainly of *dipora* are more applicable to *argiades* than to the species I choose to call *parrhasius*, and if this be not *parrhasius* then it is unnamed. It is an Indo-Malayan tropical form, *argiades* being essentially palæarctic. I have seen specimens both of *argiades* and *parrhasius* (as I accept it) under the names of *parrhasius* and *dipora*. I have not seen the type specimens of these forms. At present I am merely dealing with *argiades* (and *coretas*) and with *parrhasius* only as bearing on *argiades*.

Parrhasius, vaguely defined as ranging from India to Australia, and in its Indian races sunk under *argiades* by many authorities, has appendages, that, when we note the great similarity of those of *argiades*, *coretas*, *amyntula*, and *minimus*, may be called exceedingly different.

The distinction in wing-markings that is most constant between *argiades* and *parrhasius* is that the spots beneath are black in *argiades*, but nearly of the ground colour in *parrhasius*, being marked off by the paler circles round them.

Argiades appears to occur in only the northern and mountainous districts in India. The differences between the appendages of *argiades* and *coretas*, though slight, affect several distinct parts of the structure. The clasps in *coretas* are wider and heavier basally, the outer angle of the base being full and receding somewhat and more firmly attached to the basal ring. In *argiades* this attachment is less and the angle looks much more rounded off, than in *coretas*. The long spine of the clasp is in *coretas* long, slender, and straight, as compared with the shorter, thicker, and more curved form in *argiades*. The spiculation of its extremity affects a rather greater length than in *argiades*. This form of the spine makes what we may call the shoulder more sloping in *coretas*, more square and angular in *argiades*. The soft hair-clothed division of the clasp is more slender in *argiades* and carries only one or two hairs at most, lower than a point approximately level with the division of the clasp into the two branches, below this where the two clasps oppose each other is a considerable glabrous surface;

this area, glabrous in *argiades*, carries a considerable number of hairs in *coretas*.

The hooks or parameres of the dorsal piece (tegumen) are longer and more slender in *coretas*, the terminal portion though longer is not so sharp as in *argiades*, and the latter has a large rounded flap at the base of this terminal portion, that does not exist in *coretas*. The *œdœagus* is more robust in *coretas*, more slender in *argiades*.

Amyntula is *coretas* in most respects, it is *argiades* in the curvature, shortness and stoutness of the spiculation, of the spinous process, and also in the rather more slender soft-process.

There is considerable variation in the size of the appendages in both *argiades* and *coretas*. I have not examined enough examples to assert that this corresponds with the size of the insect or with the geographical distribution.

Explanation of Plates XIX, XX.

[*See Explanation facing the* Plates.]

XVIII. *Descriptions of some new* Hesperiidæ *from Central and South America.* By Hamilton H. Druce, F.L.S., etc.

[Read June 3rd, 1908.]

Plate XXI.

The present paper contains descriptions of some new forms of conspicuous genera and the types are contained in our own collection. Through the kindness of Colonel C. Swinhoe I have been able to carefully examine Plötz's volumes of MS. drawings and thereby identify many of his species described in the volumes of the Stettin Ent. Zeit. Dr. Godman's paper on the American species described by this author (Anns. Mag. Nat. Hist., ser. 7, v. xx, 1907) has practically cleared up all difficulties in connection with those on which his paper treats.

On a recent visit to Paris I have shown all the species described herein to M. Mabille, who agrees that they are new, excepting the form I propose to call *Croniades auraria.* And my best thanks are due to him for his kindness in showing me his collection and many of his types.

M. Mabille is responsible for Fasc. XVII, Fam. HESPERIDÆ of Genera Insectorum published by M. P. Wytsman in Brussels in 1904, which, although useful to students of this family, is unfortunately very incomplete. I propose now to deal only with the sub-family *Pyrrhopyginæ* and the first few genera of Hesperiinæ as arranged by him, and give here a list of species which he has entirely omitted, but at the same time I am not prepared to say these are all.

In the genus *Pyrrhopyge* he does not mention—

P. anina, Plötz, Stett. Ent. Zeit. p. 533 (1879). MS. drawings, pl. 1274 = *C. styx*, Mosch. fide Plötz.

P. rufinucha, G. & S., P.Z.S. 1879, p. 151. A distinct species with a red collar.

P. bogotana, Rkt. Acad. Nat. Sci. Philad. 1868, p. 89. A synonym of *P. hygicia*, Feld. (misspelt *hygiæa*, p. 3, No. 33).

P. creona, Druce, Cist. Ent., p. 290 (1874), of which M. Mabille's *P. aurora* (Bull. Soc. Ent. Belg. 1891, Nov. Lep., pl. xiv, f. 3) is a synonym also omitted.

P. phœax, Hopff. Stett. Ent. Zeit. 1874, p. 368. Plötz, MS. drawings, pl. 1300.
P. joscpha, Plötz, Stett. Ent. Zeit. xl, p. 534 (1879), MS. drawings, pl. 1287.

Dr. Godman's drawing of the type in the Berlin Museum shows a red head, but Plötz's drawing has red palpi only.

Genus *Yanguna*.

Omitted.

Y. (Pyr.) *cosyra*, Druce, Cist. Ent. 1875, p. 363. Godman and Salvin, B.C.A. Lep. Rhop. ii, p. 258, pl. lxxiv, ff. 1, 2.
Y. (Pyr.) *parima*, Plötz, Stett. Ent. Zeit. xlvii, p. 116 (1886). MS. drawings, pl. 1597.

Genus *Metardaris*.

M. cosinga, Hew., incorrectly spelt *consinga*.

Genus *Jemadia*.

Omitted.

J. imitator, Mabille, Bull. Soc. Ent. de Belg. 1891. Nov. Lep. p. 102, pl. xiv, f. 2, probably = *J. hospita*, Butler.
J. (Pyr.) *hephæstos* (Mosch. in litt.), Plötz, Stett. Ent. Zeit. xl, p. 521 (1879). Plötz, MS. drawings, pl. 1594.
J. (Pyr.) *ulixes*, Plötz, Stett. Ent. Zeit. xl, p. 521 (1879). MS. drawings, pl. 1217.

Genus *Mysoclus*.

M. æthras, Hew. (?) No. 5, appears to be a MS. name.
M. orbius, Mabille, No. 11, is a synonym of *M. amystis*, Hew., No. 4.
M. epimachia, H.S., misspelt *epinæchia*.

Genus *Pyrrhopygopsis*.

Omitted.

P. (Hesp.) *camposa*, Plötz, Stett. Ent. Zeit. xlvii, p. 90 (1886), MS. drawings, pl. 1360.
P. (Hesp.) *quispica*, Plötz, idem, MS. drawings, pl. 1361.
P. (*Pyrrhopyge*) *maravilha*, Foetterle, Revista Paulista, p. 637, pl. xviii, f. 1 (1902).
P. (Thymele) *subvirescens*, Schaus., Pr. U.S. Nat. Mus. vol. xxiv (1902), p. 426.

Omitted.

Genus *Pseudosarbia*, Berg. An. Mus., Nac. Buenos Aires, p. 256 (1897), of which the type is *P. phœnicola*, Berg., which is like *Sarbia pertyi*, Plötz, and is probably allied to the genus *Pyrrhopygopsis*.

Genus *Phocides*.

Omitted.

P. phanias, Burm. Descrip. Rep. Arg. p. 56 (1880), stated by Berg. to = *P. palemon*, Cr.

P. charon, Feld. Wien. Ent. Mon. iii, p. 405 (1859).

P. imbreus, Plötz, Stett. Ent. Zeit. xl, p. 406 (1879), MS. drawings, pl. 1198. [Type Mus. Berol.]

Genus *Tarsoctenus*.

Omitted.

T. (*Eryeides*) *herrichii*, Herr. Schff, Prods. 1869, p. 60, no. 10. Plötz, MS. drawings, pl. 1204.

T. (*Eryeides*) *erebus*, Plötz, Stett. Ent. Zeit. xl. (1879), p. 407, MS. drawings, pl. 1201.

I suppose it would be possible to go through the whole work and find omissions and mistakes on almost every page, and I have noticed that many African species described by Dr. Butler in the P.Z.S. and also by Mr. Lathy and others are not included, but I have said enough to warn students of this difficult group not to describe as new, without further research, species that they do not find in this work, and it is to be hoped that M. Mabille will be able to revise and republish his lists. As for the indices, the less said the better. They are very inaccurate, and in more than one case names are referred to as being on pages which do not exist.

Sub-family, *PYRRHOPYGINÆ*.

PYRRHOPYGE, Hübn.

Pyrrhopyge infantilis, sp. nov. (Plate XXI, fig. 1.)

♂. Upper-side. Uniform dark indigo-blue; cilia of both wings pure white except apical third of fore-wing which is black. Underside, fore-wing dark indigo-blue with inner margin towards base brownish-black; hind-wing indigo-blue with basal half pale

bluish-white crossed by narrowly black veins. Cilia of both wings white except apical third of fore-wing, which is black as above. Anal segment and tuft, palpi and front of head, bright red; terminal joint of palpi minutely deep black. Antennæ, space between eyes, thorax, collar, and abdomen, concolorous with wings. Legs wholly black.

Expanse $1\frac{9}{10}$ inch.

Hab. Peru.

This is a curious insect much like *P. phidias*, Linn., but is smaller and has a shorter and less pointed fore-wing, and the anal angle of the hind-wing is less produced, and more rounded. The front of the head only, is red.

Pyrrhopyge cruor, sp. nov. (Plate XXI, fig. 2.)

♂. Upper-side dark indigo-blue shading to green; anal angle of hind-wing rich red. Cilia of both wings, except towards apex of fore-wing which is black and of anal angle which is red, pure white. The fore-wing is crossed just before the middle by a broad band of differently placed scales—darker than the ground colour of the wing—commencing on the subcostal nervure, where it is broadest and reaching almost to a point, to the submedian nervure. Palpi glossy black; antennæ black; head black with a long white frontal spot and white spots at the base of the antennæ and between the eyes. Collar broadly dark red. Under-side as above with the transverse fascia on the fore-wing widening out beyond the end of the cell. Legs wholly black.

Expanse $2\frac{1}{10}$ inch.

Hab. Pozuzo, Peru (800 m. I. Egg).

Perhaps nearest to *P. agenoria*, Hew., which we have also from Peru (La Merced), and which it resembles in all respects, excepting the broad dark fascia described above. *P. agenoria* has never been figured, and I have identified it from M. Mabille's collection, he having seen the type in the Staudinger cabinet.

Pyrrhopyge sanies, sp. nov. (Plate XXI, fig. 3.)

♂. Upper-side rich dark brown with bluish reflections. Fore-wing crossed rather before the middle by a semihyaline opalescent white fascia commencing broadly on the subcostal nervure and ending in a point on the submedian nervure and divided into three

by the black median nervules. Cilia pure white ; black towards the apex. Hind-wing concolorus with the fore-wing and with the anal angle rich red, and the cilia pure white from apex to the red area. Palpi, legs, and antennæ deep black ; head black with a white frontal spot and white spots between and at the base of the antennæ. Collar broadly rich red. Abdomen concolorus with wings above and below and with two minute white spots below at the base of the anal segment.

Expanse $2\frac{1}{10}$ inch.

Hab. Farinas, La Paz, Bolivia (1,500 m.).

This insect has a transverse fascia as in the preceding *P. cruor*, but it crosses the wing more obliquely. They are both perhaps allied to *P. styx*, Moschs., which has red palpi and a red anal tuft and is well figured by Plötz in his MS. drawings (Pl. 1274) as *P. anina*, Plötz.

Jemadia, Watson.

Jemadia scomber, sp. nov. (Plate XXI, fig. 4.)

♀. Both surfaces black with subhyaline spots and pale bluish bands as is usual in the genus but distinguished from all others by the broad ultra basal whitish-blue band on the fore-wing above and by the large whitish undivided basal area of the hind-wing on the same surface. On the under-side the blue bands are arranged much as in *J. hospita*, Butler, but the extreme abdominal margin appears to be black, not blue as in that species.

Expanse $3\frac{1}{3}$ inch.

Hab. Pozuzo, Peru, 5,000–6,000 ft. (Native collectors).

Although of the well-known *Jemadia* type, this form differs more from any described than any of the others differ *inter se* so far as the colour and pattern of the wings are concerned. Messrs. Godman and Salvin have shown in the "Biologia Centrali Americana" the great difference which exists in the male genitalia of the various species. *J. scomber* is the giant of the genus, being much larger than any other known. Mr. H. J. Adams has a specimen also from Peru.

Croniades, Mabille.

Croniades auraria, sp. nov.

♂. Allied to *C. pieria*, Hew., from which it differs by the position

of the central transverse subhyaline band and the more conspicuous outer marginal yellow band of the fore-wing, and by the black ultramedian band on the hind-wing being much reduced and nearly obsolete at its junction with the subcostal nervure. Under-side as above, the outer-marginal yellow band of the fore-wing even wider ; anal half of the hind-wing richer orange than the costal area. Palpi pure white ; tips black.

Expanse $2\frac{3}{10}$ inch.

Hab. Farinas, La Paz, Bolivia (1,500 m.).

Mons. Mabille, to whom I showed this insect, considered it to be *P. pieria*, Hew., but I do not hold the same opinion.

Mr. H. J. Adams has a specimen, identical, from the same locality.

Watson, P.Z.S., 1893, p. 14, states that *pieria*, Hew., and *machaon*, Hew., are probably not congeneric with *iphinous*, Latr. (the type of *Mimoniades*) nor even with each other. Mons. Mabille has recently erected a new genius for *pieria*, i. e. *Croniades* "Gen. Insect." Fasc. xvii, p. 13), which he has placed first in the list and included *machaon* with it.

Sub-family, *HESPERIINÆ*.

Thymele, Fab.

Thymele palliolum, sp. nov. (Plate XXI, fig. 5.)

♀. Upper-side ; both wings blackish-brown with the basal thirds suffused with pale shining blue. Fore-wing with a subapical row of small white dots placed near the costal margin, the middle dot being slightly nearer to the base. A median white transverse band composed of 3 quadrate spots and two small costal dots divided by the brown nervules. Under-side paler than above with dots and transverse band as above ; sprinkled with yellow scales along the costal margin from the base to the white band and opalescent-blue at the extreme base. Hind-wing dark brown with short darker central bands and sprinkled with yellow scales from base, where they are thickest, to beyond middle. Head and thorax above opalescent-blue ; abdomen brown above with blue scales. Palpi pale buff. Legs yellowish. Antennæ black, with a yellowish ring at base of club. Cilia of both surfaces slightly paler than wings.

Expanse $2\frac{1}{5}$ inch.

Hab. Carrillo, Costa Rica (*Underwood*).

At first sight like *T. brevicauda*, Plötz * (*T. eniopeus* of the B.C.A.), but on closer examination quite different.

Sub-family, *PAMPHILINÆ.*

Prenes, Scudder.

Prenes grapte, sp. nov. (Plate XXI, fig. 6.)

♂. Upper-side dark brown with the basal half dark yellowish-buff. Fore-wing with a small, oblong, subhyaline spot within and at the end of, the cell. Two minute subapical dots, a small spot above the second median nervule, a larger sagittate spot at the base of the lower median nervules and a small spot resting above the centre of the submedian nervure. Cilia of both wings pale brownish-white. Underside; ground colour paler; spots on fore-wing as above but spot on submedian nervure larger and less distinctly defined. Hind-wing; a small, circular, clearly defined, white spot in the cell, an ultramedian white band commencing in a point on the costal nervure and broadening greatly to the submedian nervure. Outer margin broadly brownish-grey, crossed by the brown nervules. Anal fold broadly brown, except anal margin, which is narrowly brownish-grey.

Head, thorax and abdomen above concolorus with base of wings. Palpi yellowish-buff, sprinkled with yellowish hairs; terminal joint black. Thorax and legs dark brown; abdomen below, with yellow spots. Antennæ black above; yellowish below.

Expanse $2\frac{1}{10}$ inch.

Hab. Peru.

Allied to *P. luctuosa*, Herr. Schäff.† (Plötz MS. drawings, pl. 426) and to *P. pauper*, Mabille, Pet. Nouv. Ent. p. 201 (1878), but differs on the hind-wing below and has the additional spot in the cell of that wing.

Aides, Billberg.

Aides incantator, sp. nov. (Plate XXI, fig. 7.)

♀. Upper-side. Both wings dark brown with the basal areas thickly clothed with yellowish-buff hairs. Fore-wing with the

* *Goniurus brevicauda*, Plötz, Stett. Ent. Zeit. xlvii, p. 83 (1886), MS. drawings, pl. 1319.

† *Goniurus luctuosa*, Herr. Schäff., Prodn. Syst. Lep. iii, p. 73 (1869).

costal margin—except the extreme base which is yellowish—cupreous, extending well beyond the middle of the cell. Four irregular, subhyaline, whitish spots, one in the middle of the cell, one each between the median nervules and one just above the submedian nervure. The three forming a row of which the centre is the largest. Cilia of both wings whitish, except at apices where they are brown. Under-side. Fore-wing cupreus; discal and basal areas blackish-brown, inner margin pale brown. Spots as on upper-side, with the addition of a small yellow streak within the costal nervure adjoining the cell spot. Hind-wing dark cupreus; brownish towards the abdominal margin. A central, irregular, silvery-white patch composed of confluent quadrate patches and two separate spots, the smaller placed near the end of the cell, the larger beyond it, above the median nervure. Cilia as on upper-side. Palpi and front of thorax yellow. Legs brown. Abdomen brown above and below, clothed with buff hairs towards base on upper side.

Expanse $2\frac{3}{10}$ inch.

Hab. Carrillo, Costa Rica (*Underwood*).

Allied to *A. æstria*, Hew., and *A. dysoni*, Godm., but distinguished by the different form of the silver marking on the under-side of the hind-wing.

Dion, Godman.

Dion gemmatus. (Plate XXI, fig. 8.)

Carystus gemmatus, Bull. Cist. Ent. I, p. 86 (1872). Lep. Ex. p. 186, t. 64, f. 2.

Dion gemmatus, Godm. B. C. A., Lep. Rhop. ii, p. 593, pl. cii, ff. 37, 38. ♂.

♀. Upper-side rich dark brown: apical half brownish-buff, darker towards apex, with dark brown veins. Under-side; fore-wing dark brown, apical half pale yellow with the veins dark brown, gradually deepening towards the margins. Apex narrowly dark brown. Cilia dark brown. Hind-wing as in ♂.

Expanse $2\frac{1}{5}$ inch.

Hab. Escazu, Costa Rica (*Underwood*).

This interesting insect is remarkable for its dissimilarity to the ♂.

There are 3 ♂♂ in Mr. Godman's collection, but no ♀.

Dion rubrinota, sp. nov. (Plate XXI, fig. 9.)

♂. Upper-side blackish-brown with the internervular spaces paler. Cilia dark brown; glossy. A large inconspicuous brown brand near the centre of the wing, placed just below the cell and divided unevenly by the lower median nervule; the smaller portion, which is rather less than one-third, being below. Under-side. Fore-wing greyish-brown, with a slightly yellowish radiating fascia beyond the middle, and crossed by black nervules and black internervular radiations originating on the margin. Cilia black. A yellowish spot at the extreme base. Hind-wing greyish-brown, crossed by black nervules and black internervular radiations, excepting the anal fold, which is broadly greyish-brown. Costal margin, above the costal nervure, wholly brick-red. A slight brick-red dash at the base of the lower wall of the cell and another red dash just below the cell from the base extending nearly to the middle of the wing. The extreme anal margin is brick-red from the base to the anal angle. Head, palpi, legs and abdomen black. Antennæ black. Eyes reddish.

Expanse 2⅛ inch.

Hab. Huancabamba, E. Peru, 6,000–7,000 ft. (*Boetger*).

Quite unlike any other described species and undoubtedly belonging to this genus. I have not seen the ♀.

Thracides, Hübner.

Thracides panimeron, sp. nov. (Plate XXI, fig. 10.)

♂. Upper-side dark indigo blue without spots or markings, paler towards outer margins. When held at an angle, the inner margin from base to beyond the middle and the median interspace from base to the brand in fore-wing and the basal half of the hind-wing appear to be shining opalescent ultramarine-blue, shading to green; as also are the thorax and base of the abdomen. Cilia pure white; except the extreme apices of both wings which are dark brown. Under-side; both wings dark greenish indigo-blue, with the costal and apical areas of the fore-wing, and the whole of the hind-wing, excepting the abdominal fold, thickly dusted with dark reddish cupreus scales. The inner margin of the fore-wing is shining dark chocolate-brown. The lower portion of the cell of the fore-wing contains a broad streak of opalescent-blue shading to green, but not extending to the extreme base. Below this, at the base of, and lying

on the median nervure, is a pale greyish-brown brand, composed of differently formed scales, and protected by a fringe of short black hairs attached to the margin of the hind-wing. Cilia as on upper-side. Palpi reddish-orange, with the terminal tip minutely black, and some blackish hairs near the eyes. Collar reddish-orange. Legs and thorax clothed with opalescent-blue hairs. Abdomen black. Antennæ black. Head metallic greenish-blue. The oblique linear brand on the fore-wing above is composed of three divisions, of which the central is a small round dot.

Expanse 2½ inch.

Hab. FARINAS, La Paz, Bolivia (1,500 m.).

This beautiful insect is not nearly allied to any described, but may belong to the group which contains the *Thracides joannisii* recently described, and figured by Mons. Mabille, in Gen. Insect. Fasc. xvii, p. 179, pl. 4, f. 2 (1904), from Chiriqui, but the absence of white spots on the fore-wing and the conspicuous orange collar distinguish it at once.

PYRRHOPYGOPSIS, Godman.

Mons. Mabille has placed this genus in the sub-family *Hesperiinæ*, although Dr. Godman has clearly shown that by its veination it belongs to the *Pamphilinæ*.

Pyrrhopygopsis lugubris, sp. nov. (Plate XXI, fig. 11).

♂. Upper-side uniform deep black without markings; cilia pure white, greyish towards apices of both wings and at anal angle of hind-wing. Under-side, dark sage-green with all the veins black; inner marginal areas of both wings broadly blackish-brown. A tuft of reddish-brown hairs on the abdomen at the base of the fore-wing. Head, palpi and legs entirely black excepting the hind tibia which bears a thick reddish-brown mane. The abdomen, which is black above and below, has several reddish-brown lateral stripes on either side and a large reddish-brown anal tuft.

Expanse 2⅜ inch.

Hab. LA PAZ, Bolivia, 1,000 m. (*Garlepp*).

Allied to *P. romula*, Druce, and *P. tenebricosa*, Hew., but distinguished by the absence of the reddish-brown shoulders on the fore-wing above, which are present in both those insects. It is also allied to *P. reedii*, Weeks, jun., well figured in his Ill. Diurn. Lep. 1905, pl. xvii,

which name, however, falls to *P. quispica*, Plötz,* as shown by reference to his MS. drawing, pl. 1361. We possess specimens from Rio Colorado, Peru, 2,500 ft., obtained by Watkins and from Charapłaya, Bolivia, 1,350 m., obtained by P. O. Simon.

P. lugubris is a much blacker insect.

Pyrrhopyge maravilha, Foetterle, Revista de Museu Paulista, p. 637, pl. xviii, f. 1 (nec xvi, f. 3), 1902, is another species belonging to this genus and is allied to the beautiful *P. camposa*, Plötz [Stett. Ent. Zeit. xlvii, p. 90 (1886)], figured in his MS. drawings, pl. 1360, from Minas Geraes, from which it principally differs by possessing red shoulders and by the absence of the bright yellow costal streak on the fore-wing below.

Pyrrhopygopsis igniculus, sp. nov.

♂. Closely allied to *P. orasus*, Druce, from which it differs in the almost complete absence of the conspicuous white basal area on the hind-wing below—it is reduced to a small spot above the costal nervure and some white scaling below the wall of the cell.

Expanse $2\frac{2}{5}$ inch.

Hab. Pozuzo, Peru, 5,000–6,000 ft. (Native collectors). La Merced, Peru, 2,500 ft., v, vi, 1903 (*Watkins* and *Tomlinson*).

Described from two specimens.

Pyrrhopygopsis caminus, sp. nov.

♂. Allied to *P. orasus*, Druce, but paler, and the white of the cilia on the hind-wing extending well into the margin of the wing on the upper-side. On the under-side the costal margin is white from the base to beyond the middle of the cell. The head, palpi and anal segment and tuft are red as in *P. orasus* and there is an additional red tuft on the abdomen at the base of the fore-wing and the fore coxæ are conspicuously red in place of the black of *orasus*.

Expanse $2\frac{1}{10}$ inch.

Hab. San Martin, Llanos of Rio Meta, Colombia (*G. D. Child*).

The red tuft on the abdomen at the base of the fore-

* *Hesperia quispica*, Plötz, Stett. Ent. Zeit. xlvii, p. 90 (1886), MS. drawings, pl. 1361.

wing below, is also found in *P. socrates*, Menet., and the red fore coxæ are found in *cleanthus*, Latr., and *telmela*, Hew., which have been placed in this genus recently by Mons. Mabille.

Pyrrhopygopsis agaricon, sp. nov. (Plate XXI, fig. 12.)

♂. Upper-side. Dark purple-brown with the basal areas of both wings tawny. Cilia fuscous; whitish towards the anal angle of both wings. Under-side sage-green with the nervules black; inner margin of fore-wing broadly and unevenly black, the black area extending well up to the subcostal nervure. The space between vein 5 and the submedian nervure blackish-brown. Head, palpi, collar and abdomen above and below, tawny. Four posterior segments of abdomen ringed with black. Fore coxæ conspicuously tawny, rest of legs black. Antennæ black.

Expanse $2\frac{1}{10}$ inch.

Hab. Bogota, Colombia.

There is a specimen in the British Museum from the Crowley bequest.

I have placed this insect in the genus *Pyrrhopygopsis* as it has a long pencil of black hairs on the abdominal fold of the hind-wing above and does not show any trace of a costal fold in the fore-wing, but it seems to me to be nearly allied to *Phocides xanthothrix*, Mabille, the figure of which in Novitates Lepid., pl. v, it closely resembles on the under-side. The large tawny areas and the tawny head and abdomen at once distinguish it. M. Mabille, although he places *E. tenebricosa*, Hew., in the genus *Pyrrhopygopsis* still includes *P. xanthothrix* in *Phocides* (Genera Insectorum, Fasc. xvii, p. 19, 1904).

Explanation of Plate XXI.

[*See Explanation facing the* Plate.]

XIX. *Further Studies of the* Tetriginæ (Orthoptera) *in the Oxford University Museum.* By J. L. Hancock, M.D., F.E.S. (Chicago.)

(Second Paper.)

[Read June 3rd, 1908.]

Plate XXII.

The author takes this opportunity to acknowledge his gratefulness to Professor E. B. Poulton, F.R.S., Hope Professor of Zoology in Oxford University, for the privilege of studying the remainder of the collection of *Tetriginæ* (*Orthoptera*). The latter collection consisted of one hundred and thirty-eight examples. Of this series, which are representative of widely varied localities, a number are new, some proving to be unique types. Still others are of historical value, having been collected by Wallace in the Malay Archipelago, and by Bates on the Amazon in South America. These insects formed part of the notable collection of W. W. Saunders, which was purchased and donated by Mrs. F. W. Hope to the Hope department of Zoology, University Museum. The author's first paper on the collection of *Tetriginæ* in the University Museum appeared in the Transactions of the Entomological Society of London; * the present paper is a continuation of that contribution.

Section *LOPHOTETTIGIÆ*, nov.

In this new section the body has a general resemblance to *Tripetaloceræ*. The vertex is often greatly widened, transverse, the eyes substylate; the structure of the antennæ is especially characteristic, being filiform and strongly incrassate, or toward the apices often more or less gradually but distinctly flattened or dilated; the pronotum is more often truncate anteriorly or little excavate at the middle of the front margin, and backwardly prolonged into a posterior process; the median carina between the shoulders frequently compresso-cristate or the dorsum strongly compressed and foliaceous; the lateral lobes of pronotum more or less laminate, reflexed outwards, and

* pp. 213-244, Plate XXI, 1907.

dentate produced or obliquely truncate behind; elytra and wings of ordinary form; the first and third articles of the posterior tarsi equal in length.

The species so far known occur in South America.

Genus Lophotettix, nov.

Resembling *Gladiotettix* (*Nephele*), but differing in having stouter, more dilated, and flattened antennæ, in the fewer antennal joints, which consist of but ten distinct articles, the somewhat stouter and more rugose body, the more distinctly compresso-foliaceous dorsum of pronotum, and in the more laminate lateral lobes.

The type is *L. brevicristatus* described below.

1. *L. brevicristatus*, sp. nov. (Plate XXII, fig. 1, *a* & *b*.)

A moderately crassate form (female) bearing a low dorsal crest between the shoulders, the body strongly rugose, ferruginous. Antennæ very thick, consisting of ten conspicuous articles (a minute barely distinguishable acute apical article might be considered as the eleventh), the first article short and thickened, the second small and globose, from the third to the seventh inclusive gradually dilated toward the individual apices, the eighth and ninth dilated at the middle and subexcavated longitudinally, the last articles pale yellow, antennæ inserted far anterior to or below the eyes; the posterior ocelli situated opposite the lower margin of the eyes. Vertex very wide, transverse, not at all produced, little more than twice the width of one of the prominent globose, substylate eyes, the front transversely imperfectly carinate, bearing on each side a small tuberculiform carinula next to the eyes opposite their anterior fourth, and foveate on each side of the obscure median carina between the middle of the eyes; frontal costa abruptly widened between the posterior ocelli, parallel, the facial carina above depressed, costa between the antennæ distinctly protuberant. Pronotum anteriorly truncate, but shallowly excavate at the middle; dorsum between the shoulders compresso-cristate (about three millimeters in height above the shoulders), the crest highest between the humeral angles, somewhat translucent punctate when held against the light, the front margin roundly excavate, dentate-crenulate, above anteriorly little angulate produced as far as the anterior sulcus; dorsal margin of crest viewed from above not sulcate but strongly sinuate; viewed in profile arcuate and crenulate-sinuate, posteriorly opposite the articulation of hind femora, suberose

and dentate; dorsum rugose and on posterior process rugose-reticulose; humeral angles not prominent and widely subrounded, process lengthily subulate, apex little upturned and acute, extended beyond the apices of posterior femora; lateral lobes posteriorly bisinuate, posterior angles distinctly laminate and terminating in a laterally produced obtuse denticle, behind minutely serrulate, truncate. Elytra of moderate size, externally punctate, substraight or concave above, strongly arcuate below, apices narrowly rounded; wings fully explicate reaching nearly to the apex of pronotal process. Anterior and middle femora elongate, margins sinuate sublobate, superior carinæ of middle tibiæ compresso-dentate at the middle; margins of posterior femora minutely serrulate and sinuate-dentate, the antegenicular and genicular lobes stout and prominent; hind tibiæ fuscous, the margins lightly serrulate and armed with rather obtuse spines, the first articles of the posterior tarsi having the third obtuse pulvilli little longer than the second.

Entire length of body, female, 14 mm.; pronotum 13 mm.; antennæ 4·5 mm.; post. femora 6 mm.

One example from Brazil, South America, in the University Museum, Oxford.

2. *L. alticristatus*, sp. nov.

Differing from the preceding species in the darker almost black body, slightly tomentose below, in the dorsum bearing a much higher foliaceous crest, and in the obliquely truncate laminate subacute posterior angles of lateral lobes of pronotum, scarcely at all dentate produced laterally.

Body rugose; vertex very wide, transverse; eyes substylate; the transverse frontal carinulæ obsolete. Antennæ black and pale annulate at the joints, articles strongly dilated towards the individual apices and margins minutely serrulate and pilose; maxillary palpi having the two last articles flattened, dilated, the penultimate article oval, pilose. Pronotum anteriorly truncate, posteriorly subulate, and little longitudinally concave; dorsal crest strongly elevated between the shoulders equal to three and a half millimeters above the humeral angles, margin not at all sulcate, viewed in profile the front margin vertical erose and flush with the anterior border of the pronotum, the convex dorsal margin sloping backward and reaching as far as the middle of the wings, forward minutely denticulate and sinuate, behind dentate, viewed from above strongly sinuate, dorsum on either side and on the process lightly reticulate. Wings fully explicate, reaching scarcely beyond the pronotal apex; elytra having venate marking, punctate, and

apices somewhat widely rounded. Anterior and middle femoral margins sinuate-sublobate ; middle femoral margins above acutely produced at the apices, the middle tibiæ pale annulate at the middle and margins little compresso-tuberculate ; apical half of tarsi black.

Entire length of body, female, to end of wings 15 mm. ; pronotum 13·5 mm. ; (posterior femora mutilated.)

One example from Brazil, South America, collected by Bates; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

3. *L. unicristatus*, Hancock, Gen. Insectorum, 48 Fasc. Orthoptera, p. 40, 1906.

This is the species mentioned as above, in "Genera Insectorum," as *Nephele unicrista*. It was described by the author from a male example from British Guiana, which is in Bruner's collection. As my former description still remains unpublished, the following note may be of interest:

Allied to *alticristatus*, resembling it in colour of body, but differing in the somewhat smaller dorsal crest of pronotum, having its front border roundly excavate, minutely serrulate, and here bearing a median denticle as in *brevicristatus*, the anterior border above angulate but not denticulate produced, the dorsal margin of crest more evenly arcuate longitudinally from the front backwards, and being here slightly rugose subsinuate but not sinuate-erose as in *alticristatus*. Wings fully explicate, reaching backward nearly to the abruptly upturned pronotal apex. The first articles of the posterior tarsi bearing very small pulvilli, the third being very little longer than the rest.

Length of the entire body of the female 13 mm. ; pronotum 12 mm. ; posterior femora 6 mm.

One example collected by Bates in Colombia, South America; from the W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

Genus Gladiotettix, Hancock.

Genera Insectorum, 48 Fasc. Orthopt. p. 40, 1906.

= *Nephele*, Bolivar.

1. *G. turgidus* (Bolivar).

= *Nephele turgida*, Bolivar, Ann. Soc. Ent. Belg., xxxi, p. 252, 1887.

One male example from Brazil, South America, collected by Bates; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

Section *CLADONOTÆ*, Bolivar.

Genus Piezotettix, Bol.

1. *P. truncatus*, sp. nov.

Resembling *cultratus* in having the margin of the dorsal crest entire, but differing in the arcuate profile and smaller stature.

Body granulate, coloured ochreous, slightly obscure fusco-marmorate on legs and median carina. Vertex wide, tumid, and elevated above the eyes, not at all transversely carinulate, but bearing a small carinula next to the eyes; frontal costa incrassate but in profile scarcely at all produced between the antennæ, the face advanced before the eyes nearly equal to one-half the width of one of the strongly conoidal eyes; superior ocelli placed much in advance of and opposite the lower fourth of the eyes; antennæ inserted barely below the anterior inferior margin of the eyes, shorter than the vertical diameter of the head; maxillary palpi little dilated. Pronotum strongly tectiform cristate, the dorsal margin of crest entire, arcuate, but not highly arched, viewed in front deltoidal; the lateral surfaces forward at the sulci rugulose, subvenose; lateral carinæ distinctly expressed; anterior margin in profile arcuate produced over and little beyond the head, angulate, subobtuse at the apex, posteriorly more sloping and abbreviated, the apex angularly truncate-incised, the process only extended to about the distal third of the hind femora. Elytra and wings wanting. Superior margins of anterior and middle femora entire, the inferior margins undulate or the anterior barely subunilobate, the mesothoracic subtrilobate; the posterior femora moderately inflated, antegenicular lobe somewhat conspicuous, the outer pagina above lightly nodulose, and externally bearing oblique rugulæ; hind tibiæ rather crassate, the margins armed with valid spines about four on the inside, and five on the outside; first articles of the posterior tarsi elongate, more than twice the length of the third, the three pulvilli subobtuse, gradually increasing in size from first to last.

Length of the entire body, female, 14·5 mm.; pronotum 11·5 mm.; posterior femora 8 mm.

One example from Morty Island, collected by Wallace; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

Genus Holoarcus, nov.

Resembling *Piezotettix*, but differing in having all the margins of the pronotal crest entire and arcuate, the summit sulcate, in the almost obsolete lateral carinæ, in the acute angled apex of posterior process, and the strongly dilated hind femora bearing denticulate margins.

Including the type *altinotus* herewith described, *Piezotettix arcuatus*, Haan, and *Piezotettix sulcatus*, Stål.

1. *H. altinotus*, sp. nov. (Plate XXII, fig. 2.)

Allied to *arcuatus*, Haan. Body ochreous-ferruginous; vertex wide, about twice the width of one of the eyes, elevated considerably higher than the eyes, tumid, with minute vestigial carinulæ on each side next to the apices of the conoidal eyes; frontal scutellum triangular and open below, very slightly arcuate between the antennæ; the antennæ short filiform, as long as the face from vertex to clypeate margin below, inserted barely below the eyes; posterior ocelli placed distinctly in advance and little below the middle of the eyes; maxillary palpi having the last articles dilated, hirsute. Pronotum strongly compresso-foliaceous, the whole crest punctate-translucent when held against the light; anteriorly advanced over and beyond the head, the dorsal margin of crest presenting a highly arcuate outline in profile but little depressed forward above the lateral lobes, the summit sulcate, posteriorly the crest more sloping than in front, the apex acute angulate and extending backwards nearly to the apices of the posterior femora; sides of pronotum little rugose bearing light radiating reticulations; the lateral carinæ very little expressed. Superior margins of anterior femora entire, the inferior lightly bidentate; middle femora elongate, margins subentire; posterior femora strongly dilated, the superior margin strongly arcuate, from the middle backward tridentate, the antegenicular and genicular lobes acute, the external pagina above longitudinally nodulose, bearing oblique rugæ forward between the carinæ but scabrous and interrupted distally; hind tibiæ rather stout, the margins armed with ten or eleven valid spines, the inner margin having about six or seven spines; first articles of the posterior tarsi elongate, the third pulvilli distinctly longer than the second. Valves of the female ovipositor having the superior glades constricted at the middle, slender and denticulate.

Entire length of body, female (same as pronotum), 13·5 mm.; posterior femora 9 mm.; width 3·5 mm.

One example from Aru Islands, collected by Wallace; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

Genus Oxyphyllum, nov.

Allied to *Xerophyllum*. Vertex wider than one of the eyes, little elevated, transversely carinate, middle carinate and strongly advanced beyond the eyes; frontal scutellum elongate gradually widened below, divided much above the posterior ocelli, just below the transverse carina of vertex between the upper part of the eyes; scutellum in profile little convexly elevated between the antennæ and sinuate between the upper part of the eyes; antennæ filiform, articles strongly elongate, inserted just between the lower margin of the eyes, the distance between them wider than that to the eyes. Pronotum strongly compresso-foliaceous, arcuate, entire, the crest thin and punctate-translucent, the summit regularly arcuate, not sulcate when viewed from above but sinuate, anteriorly extended over and beyond the head, posteriorly formed into a lengthily extended subulate acute process, passing much beyond the femoral apices; lateral lobes of pronotum posteriorly bisinuate, the posterior angles turned down somewhat obliquely and narrowly excised. Elytra oval; wings fully explicate. Anterior and middle femora little compressed, margins below somewhat lobate; posterior femora not at all dilated, elongate, the superior margins minutely denticulate, inferior margins sublobate-dentate, the antegenicular and genicular lobes small; first articles of the posterior tarsi little longer than the third.

The type is *O. pennatum*, described below.

1. *O. pennatum*, sp. nov. (Plate XXII, fig. 3.)

Body rather shining granulate; face little oblique; colour greyish-rufescent, bearing an obscure triangular marking on each side of the dorsum just above the apices of the elytra. Pronotum having the crest strongly elevated, the forward part anterior to the articulation of the hind femora regularly arcuate, behind that point gently slowing backward and slightly concave toward the pronotal apex, the process thin, acute and extended backward nearly to the apices of the outstretched hind tibiæ. Elytra oblong, finely reticulate, wings extended beyond the pronotal apex. Anterior and middle femora little compressed, the margins minutely serrulate, the inferior margins bearing two obtuse lobes; superior margins of middle femora little compressed, subundulate; hind tibiæ pale ochreous, and armed with weak spines; the first articles of the posterior tarsi

little longer than the third, all the pulvilli somewhat spiculate, the third nearly as long as the first and second combined and flat below.

Length of pronotum, female, 15 mm.; height of dorsum from humeral angles to the summit of crest 4·5 mm.; posterior femora 6 mm.; wings passing the pronotal apex 1·5 mm.

One example from Darjeeling, India, in the University Museum, Oxford.

The genus *Cladonotus*, Saussure, and its allies.

A study of the genus Cladonotus, Saussure, based on material in hand as well as the described species, would indicate that members of three genera are included within the genus as interpreted by Bolivar, that is taking the species in his "Essai" * and those described since the latter was published. These groups are presented in the following diagnostic table:

1. Pronotum bearing a ramose process or crest, the front margin produced over the head, frontal facial scutellum widely concave between the antennæ I, Type genus Cladonotus, Saussure.	
A. Pronotal ramose process nearly vertical, bimarginate-serrulate behind	*C. latiramus*, Hancock.
A.A. Pronotal ramose process distinctly curved forward, extending forward beyond the head . . .	*C. humbertianus*, Saussure.
A.A.A. Pronotal crest bifid, undulate, denticulate at the summit.	*C. echinatus*, Stål.
1.1. Pronotum destitute of ramose process, but often gibbose, or cristulate †	
2. Lateral lobes of pronotum having the posterior angles somewhat smoothly laminate, obliquely truncate, the apices rounded, not at all armed	

* Ann. Soc. Ent. Belg., xxxi, pp. 208–209, 1887.

† See description of *Gignotettix* further on, which is allied to *Cladonotus*.

3. Pronotum elevated between the shoulders, gibbose on each side of summit, flattened, declivous backwards; body asperous, viewed in front subquadrate; front margin truncate, tricarinate, not or very little produced at the middle . . . . . [TELLA, nov. II, genus CLADONO-

A. Posterior femora having the superior margin armed with three acute trigonal spines . *C. gibbosa*, Haan.

A.A. Posterior femora having the superior margin undulate, the femoral and genicular spines large, triangular . . . . . *C. beccarii*, Bolivar.

2.2. Lateral lobes having the posterior angles strongly laminate-expanded, obliquely truncate, or erose-spiniform . . . . . .

3.3. Pronotum depressed, median carina cristulate-sinuate, dorsum posteriorly strongly fossulate reticulate, between the shoulders profoundly impressed, apex of process often angulate excised or abruptly acute; rami of frontal facial scutellum only slightly separated, often angulate, protuberant above antennal insertion . . [nov. III, genus TETTILOBUS,

A. Lateral lobes of pronotum having the posterior angles strongly laminate expanded, erose-spiniform; spines of vertex elevated much above the eyes . . . . . *T. spinifrons*, sp. nov.

A.A. Lateral lobes having the posterior angles obliquely truncate, minutely serrulate . . . *T. interruptus*, Bolivar

Genus Cladonotella, nov.

(Described in the diagnostic table.)

1. *C. beccarii*, Bolivar, Ann. Mus. Civ. Nat. Genova, ser. 2a, xix (xxxix), p. 66, 1898 = *Cladonotus beccarii*.

One female example referable to this species, collected by Wallace in New Guinea; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

Genus Tettilobus, nov.

(See diagnostic table.)

Resembling *Cladonotus*, Saussure. Body depressed; vertex on each side next to the eyes acuminate produced, spiniform, the vertical spines often elevated above the eyes; facial scutellum having the rami little separated, subparallel and not concave. Pronotum anteriorly truncate, tricarinate, little compressed; median carina cristulate-sinuate; dorsum profoundly impressed between the shoulders, process behind often angularly excised or narrowly acuminate, often reaching to the apex of the posterior femora; lateral lobes of pronotum distinctly laminate expanded, either obliquely truncate and minutely serrate or erose spiniform. Elytra and wings wanting. Anterior and middle femoral margins strongly lobato-spinose, the tibiæ having the superior margins bidentate; posterior femora strongly lobato-spinose, the superior external area plurigibbose, the carinæ often bearing produced tubercles or spines; posterior tibial margins armed with spines; first articles of the posterior tarsi subequal in length, the first and second pulvilli minute or subobsolete.

The type is *T. spinifrons*, described herewith. The species *Cladonotus interruptus*, Bolivar, also belongs to this new genus.

1. *T. spinifrons*, sp. nov. (Plate XXII, fig. 4.)

Allied to *Cladonotus interruptus*, Bolivar. Dark ferruginous, little tomentose underneath; vertex nearly twice the width of one of the small globose eyes, bearing a small acute produced spine on each side next to the eyes, projecting much above the eyes; facial carina above depressed, scutellum in profile having the rami strongly angularly protuberant slightly above the point of insertion of the antennæ; posterior ocelli placed between the inferior part of the

eyes. Pronotum anteriorly truncate, behind the margin tricarinate, the prozonal carinæ compressed; dorsum forward between the shoulders rather roundly elevated, cristate; median carina strongly sinuate, but continuous throughout; dorsum profoundly fossulate-reticulate; lateral carinæ sinuate and serrulate, bearing spiniform tubercles backward, and near the apex abruptly narrowed acuminate, the apex curved upwards; lateral lobes of pronotum widely laminate expanded, subtransverse, erose, behind produced in spiniform tubercles. Anterior and middle femora strongly trilobate-spinose, superior tibial margins bituberculate; posterior femora having the apices trispinose and bearing a large triangular lobe, the antegenicular spine produced, the superior margins bearing a denticle near the middle, superior area of the external pagina multigibbose or nodulose, the external carinæ armed with one tubercle above and two below distinctly evident when viewed from above; hind tibiæ obscure fuscous with pale annulations near the knee; the third pulvilli of the first tarsal articles flat below, the first and second very small and little acute.

Length of the entire body, 9 mm.; pronotum 7 mm.; posterior femora 4 mm.

One example from Ceylon in the University Museum, Oxford.

Genus Gignotettix, nov.

(Not in preceding table.)

Related to *Cladonotus*, Saussure, but having the pronotum truncate anteriorly, and destitute of ramose process, the dorsum gibbose forward in the middle, but not gibbose on each side of summit as in *Cladonotella*; the lateral lobes having the posterior angles somewhat scabrous, laminate and obtuse, truncate obliquely behind, the margins of lobe minutely armed with setæ. Body tomentose, not bearing spiniform tubercles; stature very small, face nearly vertical; vertex very wide, bearing a tubercle on each side next to the eyes, but not acute, middle dentate-carinate produced. Pronotum shortened, truncate anteriorly, the dorsum compresso-gibbose forward, posteriorly flattened declivous, apex truncate-emarginate; prozonal carinæ small and little compressed. Elytra and wings wanting. Anterior and middle femora strongly compressed, margins distinctly lobate, superior tibial carinæ lobate, posterior femora having the proximal half crassate, the distal half reduced, superior external area and external surface below nodulose and scabrous, antegenicular lobes very large, triangular but not acute, the genicular lobes less prominent; first articles of the posterior tarsi little longer than the

third; the first and second pulvilii minute subobsolete, the third longer than the rest.

The type is *G. burri*, described herewith.

1. *G. burri*, sp. nov. (Plate XXII, fig. 5.)

Stature very small, fuscous, body destitute of ramose process and spiniform tubercles, but tomentose and scabrous; vertex very wide, more than twice the width of one of the moderately small globose eyes, trituberculate in front, the middle tubercle little produced, occiput mammiliform on each side; frontal scutellum widely separated concave between the antennæ, the facial costa above between the eyes subobsolete, facial profile advanced beyond the eyes, the rami distinctly protuberant between the antennæ. Pronotum scabrous, anteriorly truncate, between the shoulders compresso-gibbose, the summit slightly sinuate, behind the gibbosity flattened declivous, bearing a tubercle on each side; median carina very uneven; prozonal carinæ abbreviated and somewhat tuberculiform; dorsum over process nearly horizontal; lateral carinæ distinct and armed with minute setæ, apex of process emarginate, not extended to the apices of the hind femora; lateral margins at the middle distinctly elevated and tuberculate. Elytra and wings wanting. Margins of femora armed with minute setæ, superior margin of anterior femora distinctly compressed bilobate, the inferior margins bidentate, the denticle behind the apex prominent, middle femoral margins bi- or trilobate above and below; posterior femora having the external paginæ nodulose, the external carinæ below the middle obtuse tuberculate, the anterior half of femora ampliate, the posterior half reduced, the triangular antegenicular lobe more prominent than the genicular lobes; spines of posterior tibiæ valid; first articles of posterior tarsi little longer than the third.

Entire length of body, male, 7 mm.; pronotum 4·5 mm.; posterior femora 4·7 mm.

One example, No. 9346, from Pundaluoya, Ceylon, collected by E. E. Green; presented by Malcolm Burr to the University Museum, Oxford.

This interesting species is dedicated to the distinguished orthopterist, Mr. Malcolm Burr.

Genus Dasyleurotettix, Rehn.

1. *D. currici*, Rehn, Proc. Acad. Nat. Sci. Philadelphia, pp. 658–659, 1904.

Two male examples, Nos. 5836 and 5837, from S.E.

Rhodesia, Africa, Umtali, 3700 ft., October 29, 1905, presented by Guy Marshall; one male from Zambesi, Africa, 3000 ft., Victoria Falls, Rain forest, September 13, 1905, presented by Professor Hudson Beare to the University Museum, Oxford.

All three examples present shorter wings than occurs in the type examples, specimens of which are in the author's collection.

Section *SCELIMENÆ*, Bolivar.

Genus SCELIMENA, Serv.

1. *S. producta*, Serv. (?) Hist. Nat. des Orthopt., p. 762, 1839.

A male and female example having no locality given, are doubtfully referred to this species; presented by Malcolm Burr to the University Museum, Oxford.

Genus EUGAVIALIDIUM, Hanc.

1. *E. novæ-guineæ*, Bol. (?) Ann. Mus. Civ. Stor. Nat. Genova, Ser. 2, xix, p. 3, 1898.

One female example having no locality, doubtfully referred to this species. This specimen resembles the typical species from New Guinea, in the author's collection. The example in the University Museum, Oxford, bears a label on which is written "E. Mus. Leyden, 1869."

Genus CRIOTETTIX, Bolivar.

1. *Criotettix sp.*

One male example, no locality label; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford. A slender species having smooth pronotum, the head compressed, elevated, the eyes globose, and with narrow vertex.

2. *C. angulatus*, sp. nov.

About the size and general form of *tricarinatus*, Bolivar, but having the pronotal carinæ very slightly expressed; the vertex nearly equal in width to one of the eyes, not at all advanced beyond the eyes; the pronotum having the posterior angles of the lateral lobes angulate, subacute but not spined; body fuscous on the dorsum

the anterior and middle femora and sides pale, the hind femora and tibiæ fusco-variegated; wings fully explicate passing little beyond the slender process.

Entire length of body, female 12·5 mm.; pronotum 11·5 mm.; posterior femora, 5·5 mm.

The specific name *angulatus* refers to the angulate lateral lobes of pronotum.

One example from Dorey Island, New Guinea, collected by Wallace; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

The above species was compared with examples of *tricarinatus*, generously contributed to the author's collection by Professor Bolivar.

Genus Acantholobus, Hancock.

1. *A. longinotus*, Hancock, Trans. Ent. Soc. London, p. 221, 1907.

Two male examples from Sarawak, Borneo, collected by Wallace; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

2. *A. bispinosus* (Dalm.) (?) Vet. Akad. Hand., p. 77, 1818. *Criotettix bispinosus*, Bolivar, Ann. Soc. Ent. Belg. xxxi, p. 226, 1887.

One female example from Borneo, No. 7263, labelled "Tettix pallitarsus Walk"; A. De Borman's collection, in University Museum, Oxford.

This example is more slender in stature than the average specimen in the author's collection from Java, and it is not typical; it differs in the somewhat narrower vertex, and the less acuminate spines of lateral lobes. It resembles *longinotus* in stature, but the posterior angles of lateral lobes differ in bearing acuminate spines, still not so produced as in *bispinosus*. For the reasons just given it is questionably referred to this species until further specimens come to hand.

3. *A. miliarius* (Bolivar), Ann. Soc. Ent. Belg. xxxi, p. 226, 1887.

One example from Ceylon, collected by E. Ernest Green; presented by Malcolm Burr to the University Museum, Oxford.

Genus Loxilobus, Hancock.

1. *L. rugosus*, Hancock, Spolia Zeylanica, ii, pp. 135–136, Plate III, figs. 17–17*b*, 1904.

Two male and one female (No. 9470) examples from Pundaluoya, Ceylon, collected by E. Ernest Green; presented by Malcolm Burr to the University Museum, Oxford.

This species has characters assigning it a place near *Coptotettix*.

Genus Systolederus, Bol.

1. *S. ridleyi*, sp. nov.

Body cinereous, the posterior tibiæ fuscous, pale annulate behind the knee and at the middle; head scarcely exserted; vertex strongly narrowed, subelevated forward; eyes strongly approximate in front, moderately prominent; frontal costa not at all sinuate, and not produced, moderately compressed between the antennæ. Pronotum smoothly granulate, convex between the shoulders; median carina scarcely at all expressed and obliterated behind the anterior margin; anterior prozonal and humero-lateral carinæ subobliterated; apical process extended little beyond the apices of posterior femora, the three carinæ above posteriorly little distinct; lateral lobes oblique below and little reflexed outwards, the posterior angles obtuse, obliquely excised behind. Elytral apices very narrowly rounded, though moderately wide at the middle; wings reaching to the apex of pronotal process. Anterior and middle femora compressed, the length of the middle femora equal to about three and a half times the width; the third pulvillus of the posterior tarsi little longer than the rest.

Entire length of body, female, 11·8 mm.; pronotum 11 mm.; posterior femora 5·8 mm.

One example from Singapore Botanical Gardens. This species is dedicated to Mr. H. N. Ridley, who collected and presented the type example to the University Museum, Oxford. This species is closely allied to *S. cinereus*, Brunner, described from one example from Burmah (in Rev. du Syst. Orthopt., p. 105, Genova, 1893).

Genus Morphopus, Bolivar.

1. *M. folipes*, sp. nov.

Resembling *phyllocerus*. Body bearing compressed carinæ, scabrous, colour light ferruginous or rufous fusco-variegated, eyes fuscous,

dorsal disc behind the shoulders fusco-bimaculate ; vertex narrower than one of the eyes in the male, subequal in the female, little narrowed forward, transversely carinate, the carinulæ rather roundly compresso-elevated on each side, middle lightly carinate, in profile not advanced beyond the eyes ; frontal costa arcuately elevated between the antennæ, rather widely sulcate, the rami straight ; antennæ short and not as long as the head, inserted distinctly below or anterior to the eyes. Pronotum depressed, anteriorly truncate, dilated between the distinct humeral angles, carinæ laterally little compressed just behind the shoulders, the subulate apical process lengthily extended backward beyond the posterior femoral apices ; dorsum rugose tuberculate, between the shoulders bearing abbreviated carinulæ ; median carina bicristate forward, strongly sinuate just before the shoulders, the forward crest often little higher than the second elevation ; median carina posteriorly very little compressed and straight, minutely serrate ; lateral carinæ strongly compressed at the shoulders, posteriorly on the process serrulate ; prozonal carinæ, short, little expressed and parallel ; posterior angles of the lateral lobes distinctly flattened quadrate, the posterior angles obtuse, behind obliquely truncate. Elytra oval ; wings fully explicate, extended backward beyond the pronotal process in the female, or not at all in the male. Anterior femora strongly compressed, margins above sinuate, below foliaceo-trilobate, the middle lobe large with sinuate margin ; posterior femora scabrous and having the external area between the carinæ tuberculose, the external carinæ bidentate or lobate in the female ; hind tibiæ fuscous marked with white at the middle and near the knees ; first article of the posterior tarsi longer than the third, the third pulvilli little longer than the rest.

Entire length of body, male and female, 9·8–11·5 mm. ; pronotum 9–10·5 mm. ; posterior femora 4–4·5 mm.

One male and one female example from Salisbury, 5000 ft., in Mashonaland, taken November 11, 1905 ; presented by Mr. Guy Marshall to the University Museum, Oxford.

Genus Platytettix, Hancock.

1. *P. reticulatus*, Hancock, Ent. News, Philadelphia, p. 88, 1906.

One male and one female ; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

The female example bears the locality Amazon, and was

collected by Bates; the second male example is also from Brazil. The former specimen has the pronotum little more highly arcuate-cristate than the type specimen in the author's collection, from Peru, besides having the apex of the process more obtuse. Until more material is examined these minor structural differences will be ignored as being of no specific importance. This species was figured by the author in Genera Insectorum, Fasc. 48 Orthopt., Plate III, fig. 23, 1906.

Genus Crimisus, Bolivar.

1. *C. lobatus*, sp. nov.

Body rather crassate; head little exserted; eyes and vertex small; posterior femora strongly incrassate but somewhat depressed, flattened below; colour greyish-ferruginous, obscure fusco-variegated, disc of pronotum rufous. Vertex equal in width to one of the eyes, subwidened forward, the anterior carinulæ slightly roundly lobulate, median carina very small and anteriorly barely produced; frontal costa convex protuberant between the antennæ, slightly sinuate above and below, rather widely sulcate, the rami straight; pronotum distinctly widened between the humeral angles, dorsum scabrous, behind the shoulders strongly depressed, fossulate, sides little compressed; median carina sinuate and pluri-interrupted, between the shoulders little elevated, sinuate, before the shoulders compresso-elevated, posteriorly bearing a series of small compressions; process acute, not reaching to the apices of the hind femora; lateral carinæ of pronotum little compressed and entire. Pronotum planate between the prozonal carinæ; humeral angles distinct and obtuse; lateral lobes flattened, quadrate, the posterior angle obtuse, behind obliquely truncate. Elytra elongate, apices acuminate; wings abbreviated. Superior carinæ of anterior femora undulate, inferior carinæ sinuate, bearing a lobe at the outer third; superior margin of middle femora undulate; the inferior carina trilobate; posterior femora having the superior carina strongly arcuate, dentate towards the apices; first articles of posterior tarsi having the first two pulvilli acute, the third little longer than the rest and flat below.

Length of body entire, female, 8 mm.; pronotum 7·5 mm.; posterior femora 5 mm.

One example from Amazon, South America, collected by Bates; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

This species resembles *C. contractus*, Bol., a Peruvian form.

Genus Lamellitettix, Hancock.

1. *L. acutus*, Hancock, Spolia Zeylanica, ii, pp. 126–128, Plate II, fig. 6–6*b*, 1904.

One male example, No. 9399, from Havahetta, Ceylon, collected by E. Ernest Green; presented by Malcolm Burr to the University Museum, Oxford.

This species was described from a female example from Ceylon. The entire length of the male measures 12 mm. from front to end of pronotal process.

2. *L. pluricarinatus*, sp. nov.

Body slender, ferrugino-fuscous. Head very little exserted; vertex subnarrower or equal to one of the rather small eyes, frontal carinulæ on each side barely elevated, oblique, subtuberculiform; frontal costa compressed above between the eyes and the rami protuberant between the antennæ; posterior ocelli conspicuously placed between the lower third of the eyes. Pronotum moderately narrow between the humeral angles, depressed on the process; dorsum pluricarinate; median carina irregularly sinuate, bicompressed forward and posteriorly depressed but irregularly compressed; dorsum between the shoulders bearing two supplemental abbreviated carinulæ running parallel and compresso-elevated; prozonal carinæ and lateral carinæ in front of the shoulders distinctly expressed; posterior process acuminately prolonged reaching beyond the apices of the out stretched hind tibiæ; posterior angles of lateral lobes, laminate subacute, angulate, behind little subexcavate but widely and obliquely truncate. Elytral apices rounded; wings fully explicate nearly reaching to apex of pronotal process. Anterior and middle femora elongate; third pulvilli of the first posterior tarsal articles nearly as long as the first and second combined and flat below; the first and second subacute; posterior tibiæ infuscated backward towards the apices.

Entire length of body, female, 14·6 mm.; pronotum 13·5 mm.; posterior femora 5·2 mm.

One example from Deltota, Ceylon, No. 9393, presented by Malcolm Burr to the University Museum, Oxford.

This species is easily recognized by the small vertex, the slender body bearing an extremely acuminate pronotal process, and the laminate, subacute, angulate, lateral lobes, instead of the acute transversely produced angles in *acutus*.

Genus Mazarredia, Bolivar.

1. *M. sculpta*, Bolivar, Ann. Soc. Ent. Belg., xxxi, p. 240, 1887.

One female example referable to this species, from Assam, India, in the University Museum, Oxford.

The pronotal process is mutilated in this specimen; the hind femora measures only 7 mm. instead of 8·5 mm., given by Bolivar, but it agrees with the description of this insect.

2. *M. dorrea*, sp. nov.

A small abbreviated apterous form, coloured testaceous variegated with fuscous. Resembling the allied species *abbreviata*, Bolivar, inhabiting the Island of Viti. Vertex viewed from above convex at the front border, wider than one of the eyes, little widened anteriorly, the tranverse carinulæ subacutely elevated between the anterior third of the eyes, the sides sinuate, median carina little produced; frontal costa scutelliform, little elevated, viewed in front concave, abruptly widened below between the antennæ and strongly compresso-narrowed between the posterior ocelli. Pronotum abbreviated, dorsum scabrous, pluri-impressed but broadly fossulate at the base of the short process, anteriorly subtectiform, humeral angles obsolete, the apex of obtuse process barely emarginate; median carina percurrent biundulate, forward before the shoulders and posteriorly on process convexly elevated, lateral lobes having the posterior angles quadrate, obliquely truncate behind, the angles little reflexed outwards. Anterior and middle femora compressed, superior carinæ of anterior femora entire, longitudinally convex, below triundulate, sublobate; superior carinæ of middle femora obscure undulate nearly straight, the inferior carinæ triundulate-lobate; posterior femora somewhat depresso-incrassate, margins entire, the antegenicular and apical lobes acute; the three pulvilli of the first tarsal articles nearly equal in length.

Entire length of body, female, 9·5 mm.; pronotum 6·5 mm.; posterior femora 5 mm.

One example from Dorey Island, New Guinea, collected by Wallace; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

Genus Orthotettix, nov.

Related to *Mazarredia*, Bolivar, but having the body smoothly granulate, vertex narrow, the tranverse carinulæ strongly oblique

and straight extending backward to the middle of the eyes ; middle carinate ; frontal costa arcuate, in profile not sinuate, the rami branching little above the posterior ocelli, widely sulcate ; posterior ocelli placed between the lower third of the eyes ; antennæ filiform rather short, scarcely reaching to the humeral angles, inserted distinctly between the eyes. Pronotum deplanate, fossulate at the base of process, between the shoulders convex ; process of pronotum extended backward beyond the apices of the posterior femora ; lateral lobes having the posterior angles turned down, obtuse. Femora elongate, margins entire. Elytra oblong, apices rounded ; wings fully explicate ; first articles of the posterior tarsi rather longer than the third.

Type *O. obliquifrons*, sp. nov., herewith described.

1. *O. obliquifrons*, sp. nov. (Plate XXII, fig. 6.)

Body slender, granulate, colour cinereous very obscurely variegated with fuscous on sides and legs ; eyes globose ; vertex viewed in front subnarrower than one of the eyes, viewed from above bearing strongly oblique carinulæ convergent forward and extended backward on each side to the middle of the eyes, the vertex here a little widened, middle carinate, on each side somewhat foveate ; frontal costa arcuate, viewed in front rather widely sulcate, the rami evenly divergent. Pronotum anteriorly truncate, posteriorly lengthily acuminate subulate, extended much beyond the apices of the posterior femora ; dorsum deplanate, bearing two indistinct, abbreviated granulate carinulæ between the shoulders ; median carina very thin but little incrassate between the shoulders, here undulate then depressed behind, and straight on the process and less distinct ; prozonal carinae parallel, very lightly expressed ; lateral carinae passing forward on the shoulders but indistinctly expressed ; humeral angles having the carinæ more expressed, widely angulate ; posterior angles of lateral lobes turned down, obtuse. Elytra oblong having rounded apices ; wings fully explicate reaching to apex of pronotum in male. Anterior and middle femoral margins entire ; posterior femora elongate, the prægenicular lobe small, spiculate, the genicular lobe minute ; posterior tibiæ armed with small spines and serrulate ; the first articles of the posterior tarsi little longer than the third, and having the pulvilli flat below, the third longer than the second.

Entire length of body, male, 13 mm. ; pronotum 12 mm. ; posterior femora 6 mm.

One example from Sarawak, Borneo, collected by

Wallace; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

Genus Cryptotettix, Hancock.

1. *C. spinilobus* Hanc., Occas. Memoirs Chicago Ent. Society I, No. 1, pp. 14-15, Pl. I, fig. 6-6*b*, 1900.

One female example, No. 9426, without a locality label; presented by Malcolm Burr to the University Museum, Oxford.

This species inhabits Madagascar.

Genus Thoradonta, nov.

Related to *Mazarredia*. Body scabrous, occiput covered by pronotum to the eyes, head not exserted; stature small, yet somewhat stout. Vertex distinctly wider than one of the eyes, not advanced beyond the eyes, scarcely at all narrowed forward, somewhat imperfectly carinate in front but bearing little abbreviated carinulæ on each side, median carina little distinct forward and little produced, on each side subfossulate, frontal costa moderately sulcate, the rami evenly divergent, branching little behind the posterior ocelli near the vertex, posterior ocelli placed between the middle or barely below the middle of the eyes; maxillary palpi having the apical articles little compressed, often white; antennæ somewhat elongate, inserted below the eyes. Pronotum scabrous, deplanate on the dorsum, anteriorly truncate, posteriorly acute but not spinate, not extended backward to apices of hind femora or little beyond; median carina strongly compresso-sinuate; dorsum between the carinated humeral angles little dilated and bearing a supernumerary abbreviated carinula on each side; lateral carinæ behind the shoulders often little compressed and elevated above the elytra. Elytra oval; wings abbreviated or nearly perfectly explicate. Lateral lobes of pronotum having the posterior angles distinctly laminate expanded and produced in a spine or acute dentate, subtruncate behind. Anterior femora above carinate, below subundulate; middle femoral margins above undulate, below undulate-sublobate; posterior femoral margins arcuate above and below, entire or minutely serrulate, the prægenicular and genicular lobes small, posterior tibiæ somewhat dilated towards the apices, margins spinose; the first and third articles of the posterior tarsi subequal in length.

Type *T. dentata*, described herewith.

There are two species characterized as follows:

1. Lateral lobes having the posterior angles obliquely dentate produced. Species from Penang Island. *T. dentata*, sp. nov.

1.1. Lateral lobes having the posterior angles distinctly acute spinate produced, spine transverse. Species Africana, *T. spinata*, sp. nov.

1. *T. dentata*, sp. nov.

Body small, variegated with fuscous, head not at all exserted; eyes globose but rather small and not at all elevated; vertex much wider than one of the eyes, advanced nearly as far as the eyes, little fossulate on each side, middle carina little crassate forward and little produced, frontal costa in profile little protuberant between the antennæ, scarcely sinuate above and below; posterior ocelli placed between the middle of the eyes. Pronotum scabrous, deplanate, somewhat convex between the shoulders; process acute not reaching to the apices of posterior femora; median carina sinuate bicristate, roundly compresso-elevated anteriorly above the sulci, subtuberculate on the process; dorsum between the humeral angles little dilated, the angles distinctly carinate, little compressed, obtuse angulate, just behind the shoulders over the elytra the lateral carinæ compresso-elevated and here sinuous, here also at the base of process the dorsum fossulate and fuscous; abbreviated carinæ between the shoulders compressed; posterior angles of the lateral lobes laminate, flattened, acute dentate produced, behind the denticles obliquely truncate. Elytral apices widely rounded; wings barely passing the process. Posterior femora little incrassate, margins entire; the second and third pulvilli of the first tarsal articles equal in length, the first small and spiculate below.

Entire length of body, female, 7 mm.; pronotum 6 mm.; posterior femora 4 mm.

One example from Prince of Wales Island (or Penang), in the University Museum, Oxford.

2. *T. spinata*, sp. nov. (Plate XXII, fig. 7.)

Nearly allied to the preceding species, resembling it in stature and general form; colour grey; vertex wider than one of the eyes; head not at all exserted; frontal costa strongly protuberant between the antennæ, scarcely at all sinuate between the eyes; maxillary palpi having the apical articles white. Pronotum having the posterior angles of the lateral lobes strongly laminate, transversely acute spinate produced. Pulvilli of the first posterior tarsal articles

nearly equal in length, but the first and second acute; middle femora ampliate toward the bases in the male.

Entire length of body, male, 7 mm.; pronotum passing apices of hind femora 5 mm.; posterior femora 3·8 mm.

One example from "Equinoctial Africa," in University Museum, Oxford.

Genus Xistra, Bolivar.

1. *X. stylata*, Hancock, Trans. Ent. Soc. London, p. 231, 1907.

One male example from Kandy, Ceylon, collected by E. Ernest Green; presented by Malcolm Burr to the University Museum, Oxford.

The type example, a female, is in the author's collection. It is from Putlam, Ceylon.

Section *TETTIGIÆ.*

Genus Euparatettix, Hancock.

1. *E. personatus*, Bol. Ann. Soc. Ent. Belg. xxxi, p. 278, 1887.

Two male examples; one from Bengal, India; the other from Java, the latter specimen collected and presented by J. W. Miers to the University Museum, Oxford.

Two characters which distinguish this species are: the fuscous or black posterior tibiæ which bear one white annulation behind the knee, and the arcuate frontal costa which is narrowly compressed. At first sight this species recalls the genus *Systolederus*.

2. *E. pilosus*, sp. nov.

Resembling *personatus*. Head little compresso-elevated; eyes elevated above the dorsum; vertex narrower than one of the eyes; narrowed forward, not at all produced beyond the eyes; frontal costa convexly protuberant between the antennæ, little sinuate between the eyes (not arcuate as in *personatus*) the rami somewhat evenly divergent, moderately sulcate. Pronotum slightly scabrous, often fusco-bimaculate behind the disc; forward at the anterior margin and just behind the prozona constricted; median carina undulate, little compresso-elevated behind the anterior margin; humeral angles carinate, dorsum between the shoulders subconvex; posterior process lengthily subulate extended much beyond the posterior femoral apices; posterior angles of the lateral lobes rounded. Elytra oval,

apices widely rounded; wings caudate. Anterior and middle femora distinctly compressed, entire, (wider in the male) the inferior carinæ of middle femora distinctly pilose, middle tibiæ having the carinæ little compressed and distinctly pilose; posterior femora elongate, having margins entire or minutely serrulate above, the femoral lobes minute; the three pulvilli of the first posterior tarsal articles equal in length and spiculate below; posterior tibiæ fuscous bearing a white annulation behind the knee, and a second smaller ring at the distal third part. Body variably coloured, often greyish or rufo-cinerous variegated with fuscous.

Entire length of male and female (to end of wings) 11–12 mm.; pronotum 9·5–10 mm.; posterior femora 4–4·5 mm.

Three male examples from Mysore, India; one male with label bearing words "Central India," and a female with simply "India," collected by Hearsey; University Museum, Oxford.

This species is distinguished from *personatus* by the lightly sinuate frontal costa, the undulate median carina of pronotum, the more scabrous dorsum, the spiculate pulvilli of the first tarsal articles, the more compressed anterior and middle femora, and the hirsute or pilose inferior carinæ of middle femora and the compressed hirsute carinæ of middle tibiæ.

Genus Paratettix, Bolivar.

1. *P. scaber*, Thunb. Nov. Act. Ups. vii, p. 159, 1815.
= *Telmatettix burri*, Hanc. Occas. Memoirs Chicago Ent. Soc. I, No. 1, p. 10, fig. of male 5–5*a*, Plate I, 1900.

Three females, two males, and one immature, Nos. 10587–10590, 10791, and 3950. Five of this number are from Mombasa, Africa, 12 miles N.W. of Mazeras, 500 ft., Sept. 23, 1905, collected and presented by Prof. E. B. Poulton to the University Museum, Oxford. No. 3950, is from Natal, Durban, Feb. 11, 1905, collected and presented by G. F. Leigh to the Museum.

Karny has recently described a short-wing form of this species as *P. ugandensis* in Mathem. naturw. Klaase Bd. cxvi, Abt. 1, Feb., p. 26, 1907; "Orthopterenfauna des Sudans." There is one male specimen long-wing form, No. 4750, in the University Museum, which appears to be a variety of *scaber*; it is from Salisbury, 5000 ft., Mashonaland, collected by Mr. Guy Marshall.

2. *P. marshalli*, sp. nov.

Resembling *scaber*, but smaller in stature, having the vertex together with the frontal costa in profile distinctly arcuate, not at all sinuate, the antennæ short, articles not strongly elongate, the median carina of pronotum percurrent, little elevated, entire.

Entire length of body, male, 9 mm.; pronotum 7·5 mm.; posterior femora 4 mm.

The antennæ are inserted between the lower part of the eyes in this species, as they are in *scaber*. Were it not for the narrow truncate front margin of the vertex, *marshalli* might better be assigned a place in the genus *Hedotettix*, as the other characters referred to above ally it with the latter.

One example from Cape Town, Rondebosch, Aug. 17, 1905, collected and presented by Mr. Guy Marshall to the University Museum, Oxford.

The author takes pleasure in naming this species after Mr. Marshall.

3. *P. shelfordi*, sp. nov.

A short-wing form slightly scabrous, colour ferruginous obscurely fusco-bimaculate on the dorsum. Vertex slightly narrower than one of the eyes, fossulate on each side anteriorly; eyes little elevated; frontal costa rather flattened convex in profile between the antennæ and not sinuate between the eyes, widely sulcate, the rami evenly divergent. Pronotum abbreviated, cuneate posteriorly, and laterally bicarinate on process, the apex not reaching to apex of abdomen in the female; humeral angles subindistinct; prozonal carinæ not at all expressed; dorsum subtectiform forward, depressed behind the shoulders; median carina undulate; posterior angles of the lateral lobes widely rounded. Elytra of moderate size, widely rounded at the apices; wings abbreviated, only as long as the pronotal process. Anterior and middle femora compressed, somewhat hirsute; superior valves of female ovipositor strongly broadened towards the bases, acute, produced toward the apices and armed with denticles.

Entire length of body, female, 8 mm.; pronotum 6·5 mm.

One example, No. 1236, from Malay peninsula, Perak, Larut Hills, 4–5000 ft., collected and presented by Mr. R. Shelford to the University Museum, Oxford.

The legs are mutilated in the type specimen.

This species is dedicated to Mr. R. Shelford, the discoverer of the type example.

Genus Tetrix, Lat.

1. *T. contractus* (Bol.) Ann. Soc. Ent. Belg. xxxi, p. 281, 1887.
= *Paratettix contractus*, Bol.

One male and one female, examples from Singapore collected by Wallace; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum. This species also inhabits the Philippines and Borneo.

2. *T. longipennis*, sp. nov.

A typical *Tetrix* having long wings and subulate pronotal process. Stature small, body somewhat scabrous-tuberculate in the female, smoother granulate in the male; colour variable, more often fuscous, sometimes greyish or testaceous or dark covered with light granulations, disc not maculate, variably marked behind, hind tibiæ infuscated more often lighter behind the knees and distal third part. Vertex wider than one of the rather small eyes, somewhat flattened, front margin barely advanced beyond the eyes, rounded or convex, median carina little produced anteriorly; frontal costa slightly sinuate opposite the eyes, lightly convex between the antennæ; in profile the vertex and facial costa distinctly advanced beyond the eyes. Pronotum often scabrous, anteriorly truncate, posteriorly subulate, extended beyond the femoral apices; dorsum transversely tectiform, subfossulate at base of process; median carina compressed subarcuate anteriorly often undulate in the female, nearly entire in the male; humeral angles carinate; prozonal carinæ parallel, slightly expressed; lateral lobes posteriorly bisinuate, the posterior angles rounded or hebetate. Elytra oval, rather large, apices somewhat widely rounded; wings fully explicate extended beyond the apex of pronotal process. First articles of posterior tarsi twice the length of the third, the pulvilli unequal, the third equal in length to the first and second combined, straight below, the first pulvilli small, acute; anterior femora elongate margins entire; middle femora compressed, in the female the margins undulate, in the male the femora ampliate, margins entire; posterior femora elongate.

Entire length of body, male and female, 9·5–11 mm.; pronotum 8·5–9·5 mm.; posterior femora 4·5–5 mm.

Five examples from Adelaide, S. Australia, in the University Museum, Oxford.

Two examples from Mt. Wellington, Tasmania, collected

by Lea, in the author's collection. The two latter specimens are slightly smaller but agree in other respects with the foregoing description.

This species resembles *Tetrix ornata*, Say, inhabiting North America.

2*a*. *T. longipennis mutabilis*, form nov.

There is a small short-wing form of *longipennis* from the same localities, which may be given the appellation above noted. It is similar to the preceding form, the body bearing elytra but having the pronotal process and wings abbreviated, not or barely reaching to the apices of the posterior femora.

Entire length of the body, male and female, 7–8 mm.; pronotum 6·5–7·8 mm.; posterior femora 4·8–5 mm.

Nine adults and three larvæ from Adelaide, Australia, in the University Museum, Oxford.

Eight examples from Victoria, Australia, in the author's collection.

The form *mutabilis* is nearly allied to *priscus*, Bol., and may possibly be that species, but if so, Bolivar must have described his species from an immature example.

3. *T. variegatus* (Bol.) Ann. Soc. Ent. Belg. xxxi, p. 106, 1887.
= *Paratettix variegatus*, Bolivar.

Two female examples from Java referable to this species. Example No. 9332 from East Java, Montes Tengger, 4000 ft.; presented by Malcolm Burr to the University Museum, Oxford.

This species was originally described from Ceylon examples. The head is more compresso-elevated than in *Tetrix cuspidata*, Hancock, from Java. The exserted head and elevation of the vertex toward the front allies this species with *Euparatettix*, yet other characters are peculiar also to both *Tetrix* and *Paratettix*.

4. *T. ornata*, Say, Ent. i, p. 137, Plate V, 1824.

One male and one female example from America; one from "U. S."; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

5. *T. granulata*, Kirby, Fauna Bor. Amer. Ins. p, 251, 1837.

One female example from America (in all probability N. America) in the University Museum, Oxford.

The following species of American *Tetrix* and *Nomotettix* are characterized by an obtuse-conical profile to head; the frontal costa between the eyes not at all or barely excavate. These insects are labelled briefly "Amer. b." which Mr. Shelford interprets as America borealis.

6. *T. americana*, sp. nov.

A robust long-wing form of the *granulata* series; body granulate, the vertex not so angulate produced as usual, but formed in an obtuse-rounded angle in profile and not at all or indistinctly sinuate between the eyes; colour dark variegated with fuscous. Head not exserted; vertex wider than one of the moderately sized eyes, equal to about one and a half times, little narrowed forward, the front margin somewhat angulate but not so produced as in *granulata*; frontal carinulæ rounding posteriorly into the sides, little compressed; median carina compressed, extended the length of vertex, in profile elevated above the eyes and produced and rounded anteriorly; frontal costa dividing behind the posterior ocelli near the apex, rather widely sulcate, the rami evenly divergent, in profile not at all sinuate between the eyes or rarely subexcavate, the facial costa strongly advanced beyond the eyes; posterior ocelli conspicuously placed free in advance of the middle of the eyes. Pronotum granulate, truncate anteriorly, posteriorly subulate, the process extended beyond the apices of the posterior femora; dorsum tectiform, somewhat broad between the humeral angles; median carina little compressed percurrent, somewhat arcuate forward nearly straight posteriorly; lateral carinæ moderately expressed; prozonal carinæ slightly expressed and subdivergent posteriorly; lateral lobes having the posterior sinus above shallow; posterior angles rounded. Wings fully explicate; elytra oval, the apices rounded. Femoral margins entire; the first articles of the posterior tarsi nearly twice the length of the third; the third pulvilli flat below and equal in length to the first and second, acute.

Length of body entire, female, 15 mm.; pronotum 11·8 mm.; posterior femora 5·6 mm.; wings passing the pronotal apex 2 mm.

One example from "Amer. b." North America; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

6*a*. *T. americana dimorpha*, form nov.

A smaller less robust form, having short wings and abbreviated pronotum, but having other characters similar to the preceding. The frontal costa very little sinuate between the eyes, in profile the vertex obtuse angulate, not so acute as in *brunneri* or *granulata*, and easily distinguished from either of these and other N. American *Tetrix*. The dorsum smoothly granulate, the elytra small, the apices narrowly rounded, the pronotal process posteriorly acute, not reaching to the apex of posterior femora; wings shorter than the pronotal apex.

Entire length of body, male and female, 8–10 mm.; pronotum 7–8 mm.; posterior femora 5·3–6·8 mm.

Four examples from the same collection as the preceding, and from the same locality.

Genus Nomotettix, Morse.

1. *N. validus*, sp. nov.

Distinguished from all the other species by the stouter form in the female, the obtuse conical vertex in profile, strongly produced beyond the eyes, and the absence of excavation of frontal costa between the eyes. Body granulate, colour variable as in *cristatus*. Vertex nearly twice the width of one of the eyes, viewed from above obtuse angulate produced beyond the eyes, the frontal transverse carinulæ on each side roundly flexed or bent backward, little compressed; vertex narrowed forward but little ampliate between the carinulæ, on each side foveate, posteriorly mammillate, median carina somewhat incrassate, prominent, in profile elevated above the eyes and arcuate, anteriorly roundly produced; frontal costa widely sulcate, in profile united with the vertex, strongly obtuse-conical, not at all excavate between the eyes, declivous below, and at the median ocellus barely sinuate; vertex advanced beyond the eyes, equal to about four-fifths the width of one of the eyes; posterior ocelli conspicuously placed, uncovered midway between the frontal costa and front margin of the eyes. Pronotum compresso-cristate, the front margin obtuse angulate produced over the head, not so acute as in *cristatus*; median carina arcuate forward, dorsal margin straight between the humeral angles and somewhat convexly sloping posteriorly; humeral angles widely rounded; process posteriorly cuneate, extended backward nearly to the apices of the posterior femora; the superior sinus of lateral lobes shallow, posterior angles narrowly rounded. Elytra elongate, apices very narrowly rounded

or subacute ; wings abbreviated, undeveloped. Anterior and middle femora elongate, compressed, margins entire ; posterior femora elongate, superior margin arcuate forward, flattened posteriorly and minutely serrulate the antegenicular lobe of moderate size ; first articles of the posterior tarsi nearly twice the length of the third, the pulvilli straight below, the first small, the second and third elongate and subequal in length.

Entire length of body, female, 11 mm.; pronotum 8·8 mm.; posterior femora 6·5 mm.

Two female examples from N. America; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

2. *N. arcticus*, sp. nov.

A long-wing form, slender in stature, resembling *validus* in the vertex and frontal costa, but the head presents a more rounded-obtuse conical profile, the pronotum somewhat narrower between the shoulders, the median carina thinly compresso-elevated, arcuate forward of the humeral angles and subulate posteriorly, extended backward beyond the apices of the posterior femora, wings fully explicate passing the apex of pronotal process, the first articles of posterior tarsi having the first and second pulvilli little flattened below but the apices acute, and the third pulvilli little longer than the second, and distinctly flattened below.

Entire length of body, female, 13 mm. ; pronotum 10·5 mm. ; posterior femora 5 mm.

Two female examples from N. America; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

This species is at once distinguished from *carinatus* by the more tumid face and vertex, which presents a rounded obtuse-conical profile, the absence of excavation between the eyes of the frontal costa, and the more obtuse angulate front margin of pronotum.

2*a*. *N. arcticus obtusus*, form nov.

A short-wing form, probably of *arcticus*. Body small, granulate ; vertex having the front margin convex, median carina produced ; profile of head obtuse-conical ; frontal costa not at all excavate between the eyes. Pronotum having the front margin obtuse angulate, dorsum somewhat narrow between the shoulders ; humeral angles widely obtuse, the posterior process abbreviated acute, not

reaching backward to the knees of the hind femora ; median carina strongly compresso-cristate, arcuate forward before the humeral angles, sloping substraight posteriorly; posterior angles of lateral lobes obtuse. Elytra small, apical margin rounded; wings shorter than the process. Femoral margins entire ; middle femora in male somewhat ampliate ; first articles of posterior tarsi having the first two pulvilli acute, the third pulvilli elongate and longer than the third and flat below.

Entire length of body, male (to end of hind femora), 8·5 mm. ; pronotum 6·5 mm. ; posterior femora 4·5 mm.

One male example from N. America; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

Genus Prototettix, Bolivar.

1. *P. africanus*, sp. nov.

Body crassate, scabrous, strongly tuberculate, colour ferruginous variegated with fuscous, anterior and middle tibiæ pale annulate. Head not all exserted, face tumid below the eyes ; vertex narrowed forward, wider than one of the eyes, fossulate on each side and bearing small supraocular lobes and rounded frontal carinulæ, middle indistinctly carinate ; frontal costa narrowly compressed, convex between the antennæ, barely sinuate between the eyes, face below sinuate ; antennæ inserted between the lower forward part of the eyes. Pronotum incrassate, convex between the shoulders, and planate behind ; dorsum tuberculose-scabrous ; humeral angles widely obtuse ; posterior process cuneate extended backward nearly to the knees of the hind femora ; median carina strongly irregularly sinuato-interrupted, compresso-elevated forward between the sulci ; prozonal carinæ obscure, tuberculate ; lateral lobes having the inferior margin little reflected outwards, the posterior angles narrowly subobliquely excised. Elytra small, narrow, the apices subacutely rounded ; wings abbreviated. Anterior femora elongate, the inferior margins indistinctly bidenticulate ; middle femoral margins minutely tridenticulate; posterior femora elongate, margins minutely undulate-dentate, external paginæ above strongly longitudinally nodulose, the oblique rugæ externally strongly expressed ; hind tibiæ strongly incrassate, the external carinæ expanded and distinctly armed with spines ; the first articles of the posterior tarsi much longer than the third, the first two pulvilli angulate acute, the third longer than the second, flattened below.

Entire length of body, female, 13·5 mm. ; pronotum 11 mm. ; posterior femora 7·8 mm.

One adult example and five larvæ from S.E. Rhodesia, Melsetter, Gazaland, 3000 ft. Mount Chirinda, "in the forest," October 6, 1905, collected and presented by Guy Marshall to the University Museum, Oxford.

This species resembles *impressus*, differing in the shorter pronotum, and the entire lateral carinæ at the humeral angles, but behind on the process strongly interrupted, irregular, and disappearing backward before the apex. In *impressus*, according to Bolivar, the lateral carinæ present a crenulate margin and the pronotum measures 14 mm. instead of 11 mm. as given above.

Genus Rytinatettix, nov.

Resembling *Prototettix*, Bolivar, but having the stature very small, rugose-tuberculose, the posterior ocelli placed below the middle of the eyes; the vertex wider than one of the moderately small eyes, the frontal costa widely sulcate; the antennæ inserted little before (below) the eyes, the inferior lateral margins of pronotum above the insertion of the elytra sinuate or arcuately excavate; the elytra minute or small; wings abbreviated, the lateral lobes of pronotum little reflexed outwards, somewhat widely rounded and obliquely truncate or hebetate; the anterior and middle femora compressed, margins undulate-lobate, the posterior femora somewhat incrassate, and the first articles of the posterior tarsi little longer than the third.

The type is *Prototettix fossulatus*, Bolivar. To this genus also belongs the species *Prototettix lobulatus* (Stål.), Bol., both inhabiting South America. The creation of the new genus, *Rytinatettix*, leaves only the African species remaining in Bolivar's genus *Prototettix*, namely, *P. impressus* (Stål.), Bol., and *P. africanus*, Hancock. Giglio-Tos* described a species under the name *Paratettix borellii*, which appears to be synonymous with *Rytinatettix lobulatus* (Stål.).

1. *R. fossulatus*, Bol., Ann. Soc. Ent. Belg. xxxi, p. 251, 1887.

Two male examples from Rio Grande do Sul., Nos. 9258–9259, presented by Malcom Burr to the University Museum, Oxford.

These examples were previously determined by Brunner as "*Paratettix toltecus*," Saussure. The latter species, so

* Boll. Mus. Torino xii, No. 302, p. 28, 1897.

far as the author's experience goes, does not inhabit South America, but is confined to Mexico and South-Western United States. *R. fossulatus* is distinguished from *P. tolteeus* by the broader vertex, the rugose-tuberculate pronotum, and the minute elytra, which are sometimes partially hidden by the inferior lateral margin of the pronotum.

2. *R. lobulatus* (Stål), Freg. Eug. Res. Ins. Orthopt., p. 347, 1860 = *Tetrix lobulata* (Stål) and *Paratettix lobulatus* (Stål), Bolivar, and *Paratettix borellii*, Giglio-Tos. See *ante*.

One male example collected by Bates on the Amazon, South America; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

Genus Tettiella, nov.

Resembling *Prototettix*, Bolivar, but having the stature small, the eyes very small; the vertex wide, little narrowed forward, more or less advanced beyond the eyes, anteriorly the transverse carinulæ roundly flexed backward on each side, sulcate on each side of median carina, fossulate forward but mammillate posteriorly on each side of occiput. Pronotum anteriorly angulate produced over the head, between the shoulders often tumid, the humeral angles wanting or obsolete, posteriorly the process abbreviated, the apex obtuse or emarginate, not extended backward to apices of the posterior femora, the posterior angles of lateral lobes turned down but more or less obliquely excised or subrounded. Elytra and wings wanting. First articles of posterior tarsi much longer than the third.

The type is *T. arcuata* described herewith. To this genus also belongs: *Tettix dubiosus*, Bol., *Tettix latipes* (Stål), and *Tettiella conofrons*, Hancock, described further on.

1. *T. arcuata*, sp. nov.

Body small, somewhat tumid, strongly rugose-tuberculate, conspersed with pale granulations, colour pale variegated with fuscous, disc of pronotum having a pale tumose excrescence. Vertex wide, equal to twice the width of one of the eyes, narrowed forward, the front margin little advanced beyond the eyes, convex, sulcate on each side of the median carina, fossulate forward and mammillate posteriorly on each side of the occiput, in profile the vertex little elevated

and advanced beyond the eyes ; frontal costa moderately sulcate, the rami evenly divergent, in profile convexly protuberant between the antennæ, sinuate between the eyes, posterior ocelli placed between the submiddle part of the eyes ; antennæ inserted barely anterior to the eyes. Pronotum rugose-scabrous, anteriorly angulate, produced over the head ; dorsum elevated tumid forward, longitudinally arcuate, profoundly impressed behind the disc, process nodulose-tuberculose, posteriorly abbreviated, the apex obtuse emarginate ; median carina in the forward half entire, arcuate, but posteriorly sinuate becoming obsolete toward the apex ; superior lateral carinæ wanting, posterior angles of lateral lobes obliquely excised. Elytra and wings wanting. Anterior and middle femora little compressed, the inferior margin of anterior femora lightly unilobate ; the middle femora above undulate, below trilobate, the middle lobe more distinct ; posterior femora incrassate, the external area scabrous, superior margins granulate and subdentate before the knee, the prægenicular and genicular lobes moderately acute ; hind tibiæ somewhat incrassate, little ampliate toward the apices, armed with acute spines ; first articles of posterior tarsi nearly twice the length of the third, the first and second pulvilli acute, the third flat below and nearly equal in length to the first and second combined.

Entire length of body, female, 8·8 mm. ; pronotum 7·5 mm. ; posterior femora 5 mm.

Two female examples from Cape Town, Africa, 100 ft., Rondebosch, August 17, 1905, collected and presented by Mr. Guy Marshall to the University Museum, Oxford.

2. *T. conofrons*, sp. nov.

Stature small, granulate, or little rugose. Resembling *Tettix latipes*, Stål, but having the vertex strongly advanced beyond the eyes, the facial costa barely sinuate between the eyes, head in profile conical, the apex little elevated anteriorly. Pronotum anteriorly obtuse angulate produced, more obtuse in the female, posteriorly not extended to the knees of hind femora, the apex somewhat narrowly obtuse emarginate ; dorsum in female transversely subtumid between the shoulders, or little compresso-tectiform in the male, not impressed behind the disc ; median carina longitudinally convexly arcuate, posteriorly disappearing near the apex ; humeral angles somewhat obscure, nearly straight ; posterior angles of lateral lobes little obliquely excised. Elytra and wings wanting. Anterior and middle femora little compressed, the inferior margins of anterior femora subundulate, of middle triundulate ; the first and second pulvilli

of first tarsal articles small, acute, the third longer than the second, and flat below.

Entire length of body, male and female, 6·5–7·5 mm.; pronotum 4·7–5·5 mm.; posterior femora 3·5–4·5 mm.

Two examples, Nos. 11051 and 11060, from Cape Town, 100 ft., Rondebosch, August 17, 1905, collected and presented by Mr. Guy Marshall to the University Museum, Oxford.

Genus Coptotettix, Bolivar.

1. *C. planus*, Bolivar, Ann. Soc. Ent. Belg. xxxi, p. 289, 1887.

One female example from Port Essington, Australia, in the University Museum, Oxford.

2. *C. parvulus*, sp. nov.

A small form with undeveloped wings and abbreviated pronotum; allied to *rufipes*, Bolivar. Body dark gray variegated with fuscous; vertex rather wider than one of the eyes, flattened, fossulate on each side forward; frontal costa little produced beyond the eyes, barely sinuate, narrowly compressed; antennæ inserted between the lower part of the eyes. Pronotum somewhat depressed, rugose, between the shoulders bearing abbreviated carinulæ; humeral angles widely obtuse, nearly straight, process extended backward nearly to the knees of hind femora; lateral carinæ not percurrent forward on the shoulders; median carina undulate, interrupted; posterior angles of the lateral lobes narrowly excised, superior sinus very shallow, the inferior deeply angularly excavate. Elytra oval; wings abbreviated. Anterior and middle femora little compressed, subentire; posterior femora elongate, the prægenicular lobes moderately acute produced, three pulvilii of first tarsal articles acute, and subequal in length.

Entire length of body, male, 7·5 mm.; pronotum 6 mm.; posterior femora 4 mm.

One example, No. 10944, from Zambesi, 3000 ft., Victoria Falls, Africa, "Rain forest," September 13, 1905; collected and presented by Professor Hudson Beare to the University Museum, Oxford.

3. *C. tuberculatus*, Bol., Ann. Soc. Ent. Belg. xxxi, p. 291, 1887.

Two female examples, Nos. 7264–7265, from Borneo; A. de Bormans' collection, labelled "Tettix similis Krauss."

Genus HEDOTETTIX, Bolivar.

1. *H. gracilis*, Haan, Bijdrag. Orthopt. p. 169, 1845.

Two female and three male examples from Madras, India; University Museum, Oxford.

2*a*. *H. gracilis abortus*, Hancock, Spolia Zeylanica, ii, p. 151, 1904.

Two female examples of this short-wing form from the same locality as preceding (Madras, India); University Museum, Oxford.

3. *H. punctatus*, sp. nov.

A very distinct species, with unknown habitat, resembling *gracilis*, Haan, but having the anterior femora little compressed, the pronotum strongly compresso-cristate, the front margin very distinctly angulate produced over the head, the median carina forward strongly arcuately elevated between the shoulders, very thin and the punctulations translucent when held against the light; the vertex subnarrower than one of the eyes, the front margin obtuse angulate, middle carinate, in profile obtuse but not distinctly rounded, the frontal costa somewhat narrowly sulcate, compressed, the rami subparallel; the wings caudate.

Entire length of body, female, 14·5 mm.; pronotum 11 mm.; posterior femora 5·8 mm.

One example, locality unknown; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

4. *H. affinis*, Bol., Ann. Soc. Ent. Belg. xxxi, p. 285, 1887.

One female example referable to this species from Port Essington, Australia.

5. *H. angustatus*, sp. nov.

A very slender form occupying the border line between *Hedotettix* and *Paratettix*. Body granulate, head very little exserted; antennæ inserted between the lower part of the eyes, articles elongate; eyes little elevated; vertex narrower than one of the eyes, scarcely at all narrowed, or ampliate forward, longitudinally fossulate, in profile advanced beyond the eyes; frontal costa narrowly sulcate, in profile not at all sinuate, convex between the antennæ. Pronotum anteriorly truncate, very narrow between the shoulders; median carina

percurrent, entire, but little elevated, scarcely convex forward and nearly straight on the lengthened posterior process; lateral carinæ distinct; process lengthily extended beyond the apices of posterior femora. Anterior and middle femoral margins entire; posterior femora narrow elongate. Elytra oval; wings caudate, the first and third articles of the posterior tarsi nearly equal in length, the first and second pulvilli acute, the third flat below and longer than the second.

Entire length of body, male and female, 12–13·5 mm.; pronotum 7·8–9·5 mm.; posterior femora 4 mm.

One male and one female from Sarawak, Borneo, collected by Wallace; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

Two male examples from Banguey, Borneo (Staudinger coll.), in the author's collection.

Genus Micronotus, Hancock.

1. *M. caudatus* (Sauss.), Orthopt. nova Amer. in Rev. et Mag. de Zool. p. 30, 1861.
= *Tettix caudatus*, Saussure, = *Paratettix caudatus*, Bolivar.

This species is common in South America and the West Indies. It is subject to considerable variation especially in the female, with respect to the undulation of the median carina of pronotum; just behind the anterior margin it is often cristulate, then taking an undulating course backward, it varies in the size and number of undulations. Represented by nine examples in the University Museum, Oxford, as follows: Three males and one female from Rio de Janeiro (probably), presented by J. W. Miers; one female from Rio Grande do Sul, No. 9256, presented by Malcolm Burr and identified by Brunner v. Wattenwyl; two examples from Island of St. Vincent, West Indies; one example from Brazil (D. Swainson's coll.); one female from Trinidad, West Indies, from W. W. Saunders' coll., presented by Mrs. F. W. Hope.

2. *M. dubius*, sp. nov.

Resembling *hancocki*, Bruner. Body very small, having the frontal costa very slightly sinuate between the eyes; the median carina of pronotum irregularly and minutely sinuate; the dorsum somewhat scabrous, the inferior margin of the middle femora

minutely bilobate. The type presents a light marking covering the disc of the pronotum.

Entire length of body, female, 6 mm.; pronotum 5 mm.; posterior femora 3·3 mm.

One example, from "America Æquatorialis," in the University Museum, Oxford.

Genus Apotettix, Hancock.

1. *A. proximus*, Hanc., Trans. Ent. Soc. London, p. 237–238, 1907.

These examples have long wings, the body rufescent, the posterior femora striate longitudinally below with fuscous, the tibiæ black, but pale annulate. The pronotal process extends backward beyond the hind femoral apices. This form differs from the short-wing type form, and may bear the distinctive name, *A. proximus appositus*, form nov.

Entire length of body, male, 12 mm.; pronotum 10 mm.; posterior femora 5 mm.

Two male examples from Cachabi, Ecuador, collected by Rosenberg; presented by Malcolm Burr to the University Museum, Oxford.

Section *BATRACHIDEÆ*, Bolivar.

Genus Halmatettix, nov.

Resembling *Batrachidea*, Serville, but differing in having the pronotum compresso-cristate, in the absence of the posterior elytral sinuses, in the apterous body, and in the unarmed femoral apices. Body granulate; face slightly oblique, crown covered by the pronotum; vertex wider than one of the eyes, truncate anteriorly, bearing small carinulate lobes on each side next to the eyes, and distinct supraocular lobes behind; median carina wanting, frontal costa moderately sulcate, the rami slightly incrassate, in profile distinctly advanced beyond the eyes, the facial carina above moderately compressed; antennæ inserted barely below the inferior margin of the eyes; eyes sub-conoidal in profile, of moderate size, but somewhat prominent; maxillary palpi having the apical articles strongly dilated and pale coloured. Pronotum tectiform, the dorsum compresso-cristate, arcuate forward, posterior process not reaching to abdominal apex, the anterior margin strongly acuminate, produced over the head and strongly uncinate; median carina compressed, thin and entire; prozonal carinæ slightly evident, subparallel,

humeral angles substraight, lateral lobes posteriorly without elytral or inferior sinuses. Elytra and wings wanting ; anterior and middle femora slender, margins entire, the superior carinæ not at all spined at the apices.

The type is *Halmatattix cristinotus*, herewith described :

1. *H. cristinotus*, sp. nov. (Plate XXII, fig. 8.)

Body somewhat incrassate, conspersed with light granulations, coloured ferrugineous variegated with fuscous, the lateral margins and underneath black ; vertex little wider than one of the eyes. Pronotum having the acute apex in front advanced barely beyond the frontal costa, the posterior process obtuse, acuminate toward the apex ; lateral margins bicarinate ; median carina thinly compressed; elevated, punctate translucent when held against the light.

Entire length of body, female, 14·5 mm. ; pronotum 13 mm. (posterior femora mutilated).

One example from Rio de Janeiro (probably), Brazil, collected and presented by J. W. Miers to the University Museum, Oxford.

Genus Scaria, Bolivar.

1. *S. ferruginea*, sp. nov.

Body moderately crassate, ferruginous, not at all fasciated with fuscous on sides or striate above ; head little compresso-elevated, the base of eyes lower than the summit of middle of dorsum ; vertex slightly tumid, somewhat smooth granulate, roundly deflexed in front, bearing indistinct small oblique carinulate lobes on each side next to the eyes ; frontal costa rounded, little protuberant between the antennæ, narrowly sulcate ; eyes large and globose. Pronotum anteriorly produced in a rather valid uncinate spine, the base little oblique ; median carina percurrent, nearly horizontal, somewhat compressed and incrassate forward, little ascendant near and toward the front, but posteriorly toward the apex of process indistinct ; lateral carinæ percurrent forward on the shoulders and distinctly expressed, process extended beyond the posterior femoral apices. Elytra having each of the bases ferruginous but posteriorly black and bearing a distinct pale præapical macula ; wings fully explicate extended beyond the apex of pronotal process. Middle femora armed with an apical spine ; anterior femora not armed at the apices; posterior femora having the inferior part fuscous but obscured by a covering of pale granulations ; inside of hind femora

infuscate, hind tibiæ ferruginous, obscurely infuscate at the middle part. The subgenital plate of the female abdomen having the apical marginal sinus broadly and yet quadrately excavate, equal in width to the bases of both inferior blades of ovipositor, the small angulate lobe thus formed on each side smooth, underneath the subgenital plate is infuscate.

Entire length of body, female (front to end of wings), 15 mm.; pronotum 12·8 mm.; posterior femora 7·5 mm.

One example from Brazil, S. America, collected by Bates; W. W. Saunders' collection, presented by Mrs. F. W. Hope to the University Museum, Oxford.

2. *S. brevis*, sp. nov.

Male.—Colour: dorsum of pronotum, vertex, and the anterior and middle legs brownish ferruginous, face below the eyes and lateral lobes below the middle pale yellow; lateral lobes above obscurely infuscated or pale granulate; the elytra, posterior femora, and hind tibiæ dark infuscate; abdomen pale yellow toward the apex. Body small, pronotum and wings abbreviated, elytra immaculate; head little compresso-elevated, the base of the large globose eyes much lower than the middle dorsal summit; vertex smooth, sides convergent forward, nearly equal in width to one of the eyes, viewed from above the frontal costa barely protrudes beyond the anterior border; frontal costa narrowly compressed between the antennæ, in profile convex, the face oblique. Pronotum very small, anteriorly produced in an elevated uncinate spine, posterior process acute not at all extended backward to the knees of hind femora; median carina percurrent, little obliquely ascendant forward, and horizontal posteriorly; prozonal carinæ subexpressed; lateral carinæ distinct at the humeral angles, anterior and middle femoral apices not at all spined.

Entire length of body from front to apices of hind femora, 9·7 mm.; pronotum 7·5 mm.; posterior femora 5·5 mm.

One example from Cachabi, Ecuador, 500 ft., Nov. 1906, collected by Rosenberg; presented by Malcolm Burr to the University Museum, Oxford.

Explanation of Plate XXII.

[*See Explanation facing the* Plate.]

XX. *Heredity in six families of Papilio dardanus*, Brown, *Subspecies cenea*, Stoll., *bred at Durban, by* Mr. G. F. Leigh, F.E.S. By Edward B. Poulton, D.Sc., M.A., LL.D. (Princeton), F.R.S., etc., Hope Professor of Zoology in the University of Oxford, Fellow of Jesus College, Oxford.

Plates XXIII and XXIV.

[Read June 3rd, 1908.]

Between September 1902 and March 1905 Mr. G. F. Leigh has bred families twice from each of the three mimetic female forms of the south-eastern subspecies of *Papilio dardanus*, Brown. The whole of the resulting material, with the exception of a portion of the first family, exists in the Hope Department, and it is of sufficient magnitude to justify a general account and to support certain important conclusions.

The first section of this paper will deal with the hereditary relationship of the several female forms. Evidence will be produced in favour of the conclusion that their proportion, at any rate in certain localities, is due in part to the proportion and in part to the relative conspicuousness of the Danaine models.

The second section will deal with the hereditary relationship in certain elements of the mimetic pattern. The attempt will be made to show the manner in which the details of the mimetic forms have been brought to resemble those of their models.

The unfortunate clerical errors in Professor Weismann's recent use of this species as an example of mimicry ("The Evolution Theory," English transl., Lond., 1904, vol. i, Pl. I) render it very desirable that the female forms should be again represented in coloured figures, together with their models. A full correction of the mistakes here referred to will be found in the writer's "Essays on Evolution," Oxford, 1908, pp. 375, 376, from which the following passage is quoted:—"Professor Weismann's prolific labours and great discoveries give an authority and influence to these unlucky copyist's errors, and therefore it is of the utmost importance to set them right in detail" (p. 375).

Very beautiful drawings of both surfaces of the *hippocoon*, F., parent of Family 4 and of an example of each mimetic form among its female offspring, as well as of their Danaine models, have been made by my friend Mrs. P. P. Whelpley. I desire to express my warm thanks to her for this beautiful work and the great care and skill required for its production. Mr. Abbott H. Thayer, who saw the painting, assured me that the colouring was as perfect as it could be made. Messrs. André & Sleigh have devoted great pains to Plate XXIII, containing a reproduction of the painting on the reduced scale which was unfortunately necessary. The Danaine models were all captured by my kind friend Mr. G. A. K. Marshall within a few miles of the localities where Mr. Leigh took the parents of these families.

Hereditary influence upon the details of pattern is especially well studied in Family 5, of which all the significant members are reproduced in half tone on Plate XXIV, prepared by Messrs. Witherby from a beautiful photograph by Mr. Alfred Robinson of the Oxford University Museum.

Section I

Hereditary relationship of the female forms of P. dardanus, subsp. cenea, at Durban.

The one striking result which is evident on a glance at the table on p. 429, is the predominance of the *cenea* female form in the offspring of each of these families. Whether the parent be *cenea* itself or the very different *hippocoon* or *trophonius*, *cenea* is invariably most numerously represented in the offspring. In two cases no other form appeared, and in two more only a single example of another form.

The results obtained by breeding from *cenea* are very concordant—in both cases a vast preponderance of *cenea*, and in one case 1, in another 3 examples of *hippocoon*. When *trophonius* was the parent only very small numbers of offspring were reared, but the results are concordant:—only *cenea* when the numbers are very small; *cenea* with a single *trophonius* when they are larger. The results yielded by *hippocoon* were, on the other hand, astonishingly different:—in one case only *cenea*, in the other the highly remarkable Family 4 with a larger pro-

The results obtained * are set forth in the following table, in which the *cenea* female forms are considered as one, and not divided according to the white or ochreous tint of the spots in the fore-wing.

♀ PARENTS.		OFFSPRING.				
MIMETIC FORM OF FEMALE PARENT.	DATE OF CAPTURE.	MALES.	FEMALE FORMS.			COMPARATIVE DEVELOPMENT OF THE BLACK H.W. BAND OF ♂.†
			Cenea.	*Hippocoon.*	*Trophonius.*	
1. *Cenea*, Stoll.	Sept. 18, 1902.	18	24	3	—	C
2. *Trophonius*, Westw. . .	Sept. 18, 1903.	3	2	—	—	C
3. *Trophonius*	May 4, 1904.	6	6	—	1	A
4. *Hippocoon*, F.	Aug. 3, 1906.	14	8	3	3	C
5. *Cenea*	Jan. 14, 1907.	15	16	1	—	D
6. *Hippocoon*	March 26, 1907.	17	13	—	—	B
Totals		73	69	7	4	

* An account of the first and second families was published by Mr. G. F. Leigh in Trans. Ent. Soc. Lond., 1904, p. 677, Plate XXXI; the third was described by the present writer in Trans. Ent. Soc. Lond., 1906, p. 281, Plate XVII; the fourth is briefly referred to in "Essays on Evolution," 1908, p. 72, n. 1; the fifth and sixth families are now recorded for the first time.

† The letter A represents the lightest development of the band, D the heaviest. See Plate XXIV, figs. 2-6, for a transitional series from lightest to heaviest as regards this character in five males of Family 5.

Of Family 1 the male and female parents, 6 males, 6 *cenea*, and 2 *hippocoon* are in the Hope Department. Of all the other families the female parent and the whole of the tabulated offspring except one male of Family 6, which escaped, are in the Department.

portion of both *hippocoon* and *trophonius* than any other. Looking at the six families as a whole, five yield concordant results in the vast predominance of *cenea*, while Family 4 stands apart. And even in this latter *cenea* is nearly three times as numerous as either of the other forms.

The immense preponderance of *cenea* over the other female forms in Natal has been observed in the field (Trans. Ent. Soc. Lond., 1904, pp. 687, 688). It follows from this predominance that for every male which meets and pairs with *hippocoon* or *trophonius* in Natal, several will meet and pair with *cenea*. *Cenea* ancestry will quickly predominate over that of the other forms in the males, and will also predominate in the other female forms themselves, while these latter will exert but little influence in the ancestry of *cenea*.

The two models of the *cenea* female form—*Amauris albimaculata* and *A. echeria*—are immensely predominant over any other Danaine butterfly in Natal, and especially over *Amauris niavius*, L., subsp. *dominicanus*, Trim., the model of the *hippocoon* form. The comparative rarity of the *trophonius* form in all parts of Africa, in spite of the widespread abundance of *Danaida* (*Limnas*) *chrysippus*, L., has already been alluded to by Mr. Roland Trimen, F.R.S., as a difficult problem which awaits solution (Trans. Ent. Soc. Lond., 1904, p. 688: see also p. 432 of the present memoir where the solution is attempted). In marked contrast with *trophonius*, the relative proportion of *cenea* in Natal certainly follows that of the two Danaines whose pattern it reproduces.

The interpretation offered above of the state of things proved to exist in Natal derives strong support from an investigation of these proportions in and around Chirinda Forest, Gazaland, in South-Eastern Rhodesia. A very large collection made, almost entirely in 1907, by Mr. C. F. M. Swynnerton, in this locality, has been recently examined in the Hope Department, and the numbers are sufficient to admit of fairly safe conclusions. The investigation and tabulation of the collection is still incomplete, and the figures given below will probably be slightly increased, but not to an extent which will affect the conclusions here drawn. The collection was made nearly indiscriminately, and allowing for the considerations mentioned on pp. 431, 432, the proportions of the larger species, here alone

taken into account, may be accepted as approximately correct. The numbers of *Papilio dardanus* (of which nearly all the Chirinda males possess the heavy black hind-wing band of the E. subspecies, *tibullus*, Kirby, are as follows:—

Males		24
Females		
	Hippocoon, f.	22
	Cenca, f.	1
	Trophonius, f.	1

Trophonius, mimicking *D. chrysippus*, is thus rare, as it is in Natal; but, as regards the other two female forms, the proportions are reversed, *hippocoon* being predominant and *cenca* rare. It will be of the highest interest to breed from these female forms at Chirinda. There can be little doubt that it would be found that *hippocoon* here predominates among the female offspring of a female parent of any form, just as *cenca* predominates in Natal.

When we investigate the proportions of the Danaine models at Chirinda we do not find that predominance of the black and white species of *Amauris* which is suggested by the numbers of the *hippocoon* mimetic form. The following results have been so far obtained, but a small part of the collection still remains unexamined:—

The model of *hippocoon*—*Amauris niavius*, L., subsp. *dominicanus*, Trim.		66
The models of *cenca*	*Amauris lobengula*, E. M. Sharpe	198
	„ *albimaculata*, Butler	152
The model of *trophonius*—*Danaida chrysippus*, L.		109

Amauris lobengula represents, and is probably a local form of, *A. echeria*, Boisd., which is still unknown at Chirinda. It is equally serviceable as a model for *cenca*. In addition to *dominicanus*, 22 specimens of the smaller black and white *Amauris ochlea*, Boisd., were counted; but the difference in the pattern is so great that it is unlikely that the influence upon *hippocoon* is greatly affected. Neglecting *ochlea*, the numbers of the Danaine model of *hippocoon* are less than one-fifth of those of the two models of *cenca*. Yet this small proportion is accompanied by the immense preponderance of *hippocoon* revealed in the figures quoted above. As bearing upon these interesting and, in view of the effect produced, remarkable proportions, Mr. Swynnerton tells me that *lobengula*

and *albimaculata* are so excessively abundant that his native boy would get tired of catching them, whereas he would secure every specimen of *dominicanus* that came in his way. But on the other hand, as Mr. G. A. K. Marshall and Mr. Swynnerton have both pointed out to me, the females of *dardanus* probably spend a great deal of their time actually in the forest, and within that particular environment there would be far less discrepancy between the numbers of *dominicanus* and the two other species of *Amauris*, than would appear from the above tabular statement. Nevertheless, it has been already shown that *echeria* and *albimaculata* are exceedingly effective models for *dardanus* in Natal, and the same is true of the south coast of Cape Colony. Making every allowance therefore for the above considerations, I am driven to conclude that *dominicanus* possesses some special advantages as a model over the other two species, which may compensate for a numerical inferiority. These advantages may be conferred by the far greater conspicuousness which renders it visible at a much greater distance than either *lobengula* or *albimaculata*.* It must be remembered furthermore that, although so much less numerous than the other two, *dominicanus* is quite a common butterfly at Chirinda, whereas in Natal it is generally rare, and often altogether unseen for long periods in many localities where *Papilio dardanus* is found.

It is interesting to compare *Papilio echerioides*, Trim., with *P. dardanus*. The former is also common at Chirinda, 39 males and 17 females having been so far counted. The females, as is well known, are beautiful mimics on the upper surface of *Amauris echeria* (or *lobengula*) and *albimaculata*. For this *Papilio* the latter are evidently very effective models, but for *dardanus*, with another form, mimicking the black and white Danaines, their influence in spite of preponderant numbers is entirely subordinate.

The relative rarity of the *trophonius* form in the west and east, as well as the south of Africa, in spite of the general abundance and wide range of its model, has often been remarked upon (see p. 430; also Trans. Ent. Soc. Lond., 1904, p. 688). In this case the facts are probably to be explained by difference of habitat, *chrysippus* being an open

* It would also be very interesting to investigate the relative efficiency of the special means of protection possessed by these three *Danainæ*.

country and woodland species, while *dardanus* is a forest insect. Model and mimic would ordinarily only meet at the lines of contact between their respective types of country. Both Mr. Marshall and Mr. Swynnerton to whom I have mentioned this hypothesis agree that it probably accounts for the fact.

Section II

Description of Families 4, 5 and 6: Hereditary tendencies in the details of the mimetic patterns.

The fore-wing spots of the cenea form.

Before describing the details of these three families now recorded for the first time, it will be convenient to enumerate the spots of the fore-wing of the *cenea* form, of which the five largest were described in 1904 (Trans. Ent. Soc. Lond., 1904, pp. 680, 681). The terminology then suggested will now be extended to include all the spots of the fore-wing:—

A. Spots arranged in a curve in part below and in part round the distal end of the cell.
  (1) The principal spot (oval): between veins 2 and 3.
  (2) An elongated spot: between veins 4 and 5.
  (2*a*) Rarely present (e. g. in Plate XXIV, figs. 20, 21): between veins 5 and 6.
  (3) Oval, but broader than (2): between veins 6 and 7.
  (4) The blunt distal end is commonly emarginate: between veins 8 and 9.
  (4*a*) Occasionally present (e. g. in Plate XXIV, figs. 14–19): between veins 9 and 10.

B. The spot within the cell.
  (5) An irregular spot, with the inner extremity often cut off as a separate minute spot (e. g. in Plate XXIV, figs. 1, 12, 13, 16, 17, &c.).

C. The submarginal spots, of which four are usually present.
  (α) At the anal angle; generally minute: between veins 1 and 2.
  (β) Generally larger: between veins 2 and 3.
  (γ) Generally larger still: between veins 3 and 4.
  (δ) At the apical angle, generally largest: between veins 7 and 8.

The fourth Family :—

4. HIPPOCOON, ♀ Parent (Plate XXIII, fig. 1).

Captured August 3, 1906. Laid 32 eggs, August 4–6.
Hatched August 10–12.

	OFFSPRING.		
	DATE OF PUPATION.	DATE OF EMERGENCE.	SEX AND ♀ FORM.
	1906	1906	
1.	September 8	September 19	♂
2.	No date.	September 21	♂
3.	No date.	September 22	♀ *cenea* (chief spot in fore-wing pale ochreous).
4.	No date.	September 23	♂
5.	No date.	September 23	♂
6.	September 13	September 23	♂
7.	September 13	September 24	♀ *trophonius*.
8.	September 14	September 26	♂
9.	September 14	September 26	♂
10.	September 14	September 30	♀ *cenea* (chief spot in fore-wing white. Plate XXIII, fig. 4A).
11.	September 16	September 30	♀ *cenea* (spot white).
12.	September 18	October 1	♂
13.	September 18	October 1	♀ *cenea* (spot ochreous).
14.	September 20	October 2	♂
15.	September 21	October 6	♀ *cenea* (spot white).
16.	September 21	October 7	♀ *trophonius* (Plate XXIII, fig. 3A).
17.	September 23	October 9	♀ *cenea* (spot ochreous, as also is the spot within the fore-wing cell).
18.	September 23	October 10	♀ *hippocoon*.
19.	September 24	October 13	♀ *trophonius*.
20.	September 24	October 15	♀ *hippocoon* (Plate XXIII, fig. 2A).
21.	September 23	October 15	♀ *cenea* (spot ochreous).
22.	September 25	October 18	♂
23.	September 26	October 18	♂
24.	September 26	October 19	♀ *hippocoon*.
25.	September 27	October 20	♂
26.	September 30	October 21	♂
27.	October 2	October 23	♂
28.	No date.	October 24	♀ *cenea* (spot ochreous. Plate XXIII, fig. 5A).

These results are the most remarkable hitherto attained by Mr. G. F. Leigh, all the forms being represented in considerable proportions, and the predominance of *cenea* being far less marked than in any other family.

The hippocoon parent. — A glance at fig. 1 on Plate XXIII will show that the parent is a normal *hippocoon* form with spot (5) undivided.

The fourteen male offspring.—The heaviness of the hind-wing band is about as in Families 1 and 2, viz. next to the darkest, Family 5, but separated from it by a considerable interval.

The three hippocoon offspring.—The individual represented in Plate XXIII, fig 2A, is the only one with spot (5) in the cell of the fore-wing divided. In the other two the chief white marking is smaller, suggesting the appearance of forms from the West Coast (*merope*).

The three trophonius offspring.—In all three examples a pale fulvous tint spreads from the nervules crossing the subapical white bar, and in one example also overspreads the outer half of spot (5). The lens shows that this tint is due to fulvous scales scattered over the white areas, and thickly crowded along the nervules.

Although the upper surface pattern of *trophonius* at first sight appears to be nothing more than *hippocoon* with the white of the chief marking replaced by fulvous—a view adopted by the present writer in Trans. Ent. Soc. Lond., 1906, p. 290—in certain special points it has diverged in the direction of its particular model, *chrysippus*. In the fore-wing the fulvous area invades or overspreads the black ground-colour towards the base of the cell. In the hind-wing the outer border of the fulvous area projects into the black margin between the nervules, forming a scalloped junction which, as in *D. chrysippus* itself, is more strongly marked in the costal half of the wings. The fulvous area is also more sharply marked off from the black margin than in the *hippocoon* form. These points of distinction are small and developed very variably. They are better seen when Fig. 3A is compared with Fig. 2A than when it is compared with Fig. 1.

Spot (5) is undivided in the three *trophonius* offspring.

The eight cenea offspring.—It has already been shown in the tabular statement that three of these individuals have the chief spot (1) of the fore-wing white (e. g. as in the individual shown on Plate XXIII, fig. 4A), while in

five it is pale ochreous (as in Fig. 5A). In that one specimen out of the five in which spot (1) is the palest, the spot within the cell (5) is of a pronounced ochreous tint. Spot (5) is divided on the left side of one out of the three individuals with the chief spot white: among the five with the chief spot pale ochreous it is divided in two, and on the left side in a third individual. Spot (4*a*) is shown on the upper but not on the under surface of the individual represented on Plate XXIII, fig. 5A. It can only be made out with a lens and on one side only in a single specimen out of seven remaining *cenea*. Excluding minute traces revealed by the lens, spot (2*a*) is wanting from the upper surface of all examples, but is present on the under surface of one specimen out of the three and with the chief spot white, and of two out of the five others. Other characteristics of these eight specimens are considered in the following sub-section :—

Probable hereditary effects of the hippocoon *form upon offspring of other forms.*

In all the three *cenea* offspring with the chief spot (1) in the fore-wing white, the costal third of the ochreous basal patch of the hind-wing becomes white, as is shown in Plate XXIII, fig. 4A. The ochreous tint of the remainder of the patch is also unusually pale. In the two individuals in which this change towards the costal border of the hind-wing is most marked, the chief spot of the fore-wing spreads outwards and downwards beyond the first median nervule (Fig. 4A). In all three examples there is a small ochreous linear mark towards the base of the inner margin of the fore-wing, thus very slightly extending the pattern of the hind-wing on to the fore.

In all the five *cenea* offspring with the chief spot (1) of the fore-wing pale ochreous, this linear mark is also present (Fig. 5A), but the extension of the chief spot is only found in two of them.

A whiteness towards the costal margin of the hind-wing upper surface, like that of three *cenea* females, is found in two of the males and on the left side of a third. There is also a paling of the yellow on one side in the cell of the fore-wing of a few males which has more of an abnormal appearance. The paling of the hind-wing, however, corresponds in position with that of the three *cenea*, and is probably due to the same cause.

The fifth Family:—

5. CENEA, ♀ Parent (Plate XXIV, fig. 1).

Captured January 14, 1907. Laid 42 eggs, January 15 and 16.

	OFFSPRING.		
	DATE OF PUPATION.	DATE OF EMERGENCE.	SEX AND ♀ FORM: INCREASING DEVELOPMENT OF HIND-WING BAND OF MALES INDICATED BY LETTERS A TO O.
	1907	1907	
1.	February 19	March 2	♂ C.
2.	February 19	March 3	♂ I.
3.	February 19	March 3	♂ (Plate XXIV, fig. 3) B.
4.	February 20	March 4	♂ L.
5.	No date.	March 4	♂ H.
6.	No date.	March 5	♀ *cenea* (Fig. 8).
7.	No date.	March 5	♀ *cenea* (Fig. 15).
8.	No date.	March 6	♂ J.
9.	No date.	March 6	♀ *cenea* (Fig. 20).
10.	No date.	March 6	♀ *cenea* (Fig. 12).
11.	No date.	March 8	♂ N.
12.	No date.	March 8	♀ *cenea* (Fig. 21).
13.	No date.	March 9	♂ (Fig. 5) G.
14.	February 24	March 10	♀ *cenea* (Fig. 11).
15.	No date.	March 11	♂ K.
16.	No date.	March 12	♀ *hippocoon* (Fig. 22).
17.	No date.	March 12	♀ *cenea* (Fig. 13).
18.	No date.	March 13	♀ *cenea* (Fig. 7).
19.	No date.	March 14	♂ M.
20.	No date.	March 14	♀ *cenea* (Fig. 10).
21.	March 2	March 15	♂ (Fig. 6) O.
22.	No date.	March 15	♀ *cenea* (Fig. 16).
23.	March 3	March 16	♀ *cenea* (Fig. 14).
24.	No date.	March 17	♀ *cenea* (Fig. 18).
25.	No date.	March 18	♀ *cenea*. Badly deformed.
26.	March 7	March 20	♂ (Fig. 2) A.
27.	March 9	March 22	♀ *cenea* (Fig. 17).
28.	March 12	March 27	♂ F.
29.	March 12	March 28	♂ (Fig. 4) E.
30.	March 16	March 28	♂ D.
31.	March 14	March 29	♀ *cenea* (Fig. 19).
32.	March 20	March 30	♀ *cenea* (Fig. 9). Fore-wing spots far more ochreous than in any other.

The cenea parent.—The spots round the end of the cell (1)–(4) are large and well developed, but neither (2*a*) nor (4*a*) is present. The chief spot (1) is very pale ochreous, with a minute trace of a downward extension, as if slightly in the direction of the pattern of *hippocoon* and *trophonius*. The spot in the cell of the fore-wing (5) is distinctly divided into two, making a !-like marking on the upper surface: on the under this division does not occur. The submarginal spots of the fore-wing (*a*)–(*δ*) are present (although (*a*) is very minute) and increase in size towards the apex. The parent is represented in Plate XXIV, fig. 1.

The fifteen male offspring.—These are as a whole much darker and more closely approach the subspecies *tibullus* than the males of the other five families. The development of the submarginal black band of the hind-wing is clearly shown in Plate XXIV, figs. 2–6. The band is least developed, with a pronounced anal gap (Trans. Ent. Soc. Lond., 1904, p. 683) in No. 26, represented in Fig. 2. Next in succession follows No. 3, shown in Fig. 3. Then follow two unfigured individuals, Nos. 1 and 30, succeeded by No. 29 (Fig. 4). The next individual in the order of increasing heaviness in the black band is No. 28, unfigured, and next No. 13, represented in Fig. 5. In this specimen the costal gap in the band is indicated by a few scattered yellow scales. No. 13 is the only individual in which the gap is represented in this way, although it is more distinctly indicated by a bay, as in Figs. 3 and 4, or by an angle, as in Fig. 5 itself. The darkness of the band in this family and the gradual character of the transition are seen in the fact that no less than seven unfigured specimens intervene between the one represented in Fig. 5 and the darkest individual, No. 21, shown in Fig. 6. Arranged in the order of increasing darkness these unfigured specimens are Nos. 5, 2, 8, 15, 4, 19, and 11. The specimen represented in Fig. 6 resembles a typical male of *tibullus* from the tropical East coast, and indeed, as regards the band of the hind-wing, the whole of the nine darkest individuals of this family might have come from Mombasa or German East Africa.

The remarkable serration of the inner border of the black margin of the fore-wing — an ancestral feature common in the males of this specialised subspecies, but rarely found in far more primitive forms on the African

continent*—is well seen in Fig. 6, less characteristically in Fig. 2. Half of the unfigured specimens also exhibit the same feature, while the others resemble the condition represented in Figs. 3, 4, and 5.

The sixteen cenea offspring.—All the females of this form are shown in Plate XXIV, with the exception of No. 25 which is so deformed that the pattern cannot be made out. They are arranged in three sets according to the number of the white spots grouped round the end of the fore-wing cell on the upper surface. The seven specimens represented in Figs. 7–13 on Plate XXIV possess the four usual spots (1)–(4) seen in the parent; the six represented in Figs. 14–19 have the additional spot (4*a*) on the costal and inner side of (4): the two represented in Figs. 20 and 21 have the additional spot (2*a*) between (2) and (3). A glance at the plate will show that the extra spots (4*a*) and (2*a*) tend to occur in individuals in which spots (1)–(4) are strongly developed, the only apparent exception being offered by Fig. 14. The spots of the fore-wing are large and well developed—about equal or even superior to those of the female parent—in the *cenea* offspring represented in all the Figures except 7, 8, 11, and 14.

As regards the development of a pale ochreous tint in the spots of the fore-wing, all the *cenea* forms figured are nearly in the condition of the parent except that shown in Fig. 9. In this specimen, No. 32, spots (1) and (3) are of an ochreous tint as deep as that of the hind-wing patch, while parts of spots (2) (4) and (5) also bear yellow scales. The specimen is, in fact, in this respect a good mimic of the Cape Colony forms of *Amauris echeria*.

Of the remaining *cenea*, spot (1) is whitest in the specimens shown in Figs. 11 and 15. Spot (3) as well as (1) is very pale ochreous in Fig. 16. A slight downward and outward extension of spot (1) in the direction of the pattern of *hippocoon* is developed much as in the parent in the specimens represented in Figs. 9, 10, 11, 14, 17, 19, and 21. It is considerably more developed in Fig. 18. A small pale mark on the basal part of the fore-wing inner margin—a further advance towards *hippocoon*, etc., not found in the parent—is seen in the specimens shown in Figs. 10, 11, 14, 19, 21, and in a far more advanced state in Fig. 18.

* Trans. Ent. Soc. Lond., 1906, p. 282.

It is now necessary to describe, as briefly as possible, some of the chief features in the fore-wing pattern of each of the *cenea* forms :—

Fig. 7 (No. 18) : spot (5), divided in the parent, is here undivided : a distinct trace of (4*a*) can be seen on the under surface. The marginal spots are much less developed than in the parent, (γ) and (δ) being minute and the others wanting: below (δ) is wanting also. Part of the pupal case is still adhering behind the head.

Fig. 8 (No. 6) : (5) divided on right side, undivided below : very faint traces of (4*a*) and (2*a*) can be made out with a lens on the under surface. (*a*) can be made out with a lens, (β) minute, others small. All distinct below and (γ) large.

Fig. 9 (No. 32) : (5) divided on upper surface only, but the outer portion is very minute especially on right side. The additional spots are unrepresented on under surface. (*a*)–(δ) well developed, (*a*) and (δ) more so than in parent.

Fig. 10 (No. 20) : (5) undivided : under surface as in Fig. 9; marginal spots nearly as in Fig. 8. Below (*a*) minute on left side, (β) and (γ) large, (δ) absent.

Fig. 11 (No. 14) : (5) undivided : a small but distinct trace of (2*a*) below : marginal spots absent above : below (*a*)–(γ) small and (β) barely visible on left side.

Fig. 12 (No. 10) : (5) divided distinctly above and nearly divided below : (4*a*) distinct below and a trace can be identified with a lens above : (2*a*) wanting below : (*a*) absent, (δ) minute, others normal as in parent. Below (δ) absent : others normal as in parent.

Fig. 13 (No. 17) : (5) as in Fig. 12 but the lower spot is minute, especially on right side : (2*a*) distinct below and (4*a*) a trace : marginal spots as in Fig. 12 except that (δ) is large.

Fig. 14 (No. 23) : (5) divided on left side, fused but constricted on right, below fused on both sides : (4*a*) small but quite distinct, larger below : (γ) minute, all others absent, similar below except for a minute trace of (β) on left side only.

Fig. 15 (No. 7) : (5) divided, but not below, though traces of division are distinct : (4*a*) as in Fig. 14 but rather larger : a trace of (2*a*) below : marginal spots much as in Fig. 13, but (β) even more minute above, and (*a*) absent above and below.

Fig. 16 (No. 22): deformed: yellower spots in fore-wing than any except Fig. 9: (5) divided below as well as above: (4*a*) as in Fig. 15: (2*a*) in two patches below: submarginal spots similar to parent on both surfaces, except that (*a*) is wanting above.

Fig. 17 (No. 27): (5) divided and the larger portion also nearly divided, so that the marking appears as three sub-equal spots: below the ordinary division holds and the other is indicated: (4*a*) as in Fig. 15 etc. and very distinct below: submarginal spots like parent but (*a*) (β) smaller and (γ) (δ) larger both above and below: (γ) below larger than (δ).

Fig. 18 (No. 24): (5) very large, undivided above and below: (4*a*) distinct above and below: no trace of (2*a*) below: marginal spots very similar to Fig. 17 only (*a*) absent above and minute below. The rather marked transition to *hippocoon* shown in this specimen has been already pointed out (p. 439).

Fig. 19 (No. 31): much like Fig. 18 except that a very slight trace of (2*a*) appears below, especially distinct on left side: (δ) absent above and below, others normal on both surfaces, (*a*) being minute above as usual.

Fig. 20 (No. 9): fore-wings deformed, especially on right side: (5) divided on both surfaces: (4*a*) distinct below, especially on right side, absent above: (2*a*) small on left side, large below; on right side invisible above (perhaps due to fold in wing); small below but evidently much concealed in fold: (γ) and (δ) alone present above: below on left side (right much deformed) (δ) absent but other three normally developed.

Fig. 21 (No. 12): (5) divided above but not below: no (4*a*) on either surface: (2*a*) very large both above and below: (*a*) and (β) can only be identified by a lens, (γ) and (δ) are well developed and sub-equal; below (δ) is minute on right side, absent on left, (*a*) and (β) normally developed and (γ) large.

The single hippocoon offspring. — The pattern of this specimen is well shown in Plate XXIV, fig. 22.

Fig. 22 (No. 16): (5) divided above but not below: (2*a*) is much the largest spot in the subapical bar of *hippocoon* on both surfaces. (4*a*) is absent, for a linear

white streak along the second subcostal does not appear to correspond with it: nor is this spot represented on the under surface. The submarginal spots are normal on the upper surface except for the absence of (*a*), on the lower except for the absence of (δ).

The sixth Family:—

6. HIPPOCOON, ♀ Parent.

Captured March 26, 1907. Laid ova March 27–8, and died on evening of March 28.

	OFFSPRING.		
	DATE OF PUPATION.	DATE OF EMERGENCE.	SEX AND ♀ FORM.
	1907	1907	
1.	April 26	May 10	♀ *cenea.*
2.	April 27	May 10	♀ *cenea.*
3.	April 27	May 11	♂
4.	April 28	May 12	♂
5.	April 29	May 12	♀ *cenea.*
6.	April 30	May 15	♂
7.	May 1	June 22	♀ *cenea.*
8.	May 2	June 24	♂
9.	May 3	July 27	♀ *cenea.*
10.	May 2	July 28	♂
11.	May 6	August 1	♂
12.	May 7	August 5	♂
13.	May 6	August 11	♂
14.	May 7	August 11	♀ *cenea.*
15.	May 7	August 12	♂
16.	May 8	August 16	♂
17.	May 7	August 16	♀ *cenea.*
18.	May 8	August 19	♂
19.	May 7	August 19	♀ *cenea.*
20.	May 10	August 20	♀ *cenea.*
21.	May 9	August 20	♀ *cenea.*
22.	May 10	August 25	♂
23.	May 10	August 28	♀ *cenea.*
24.	May 11	August 31	♂
25.	May 12	August 31	♂ (escaped).
26.	May 11	August 31	♀ *cenea.*
27.	May 10	Sept. 1	♀ *cenea.*
28.	May 12	Sept. 4	♂
29.	May 11	Sept. 6	♂
30.	May 14	Sept. 12	♂

It is not necessary to describe this family in any detail;

as its interest lies in the exclusive predominance of *cenea* female forms and in the astonishing contrast afforded with Family 4, also bred from a *hippocoon* parent. It is of considerable interest, as Mr. G. F. Leigh pointed out to me, that the pupal condition of the great majority of examples was prolonged through the winter months, although a certain number emerged after the usual period.

The hippocoon parent.—The specimen is a normal example of this form with spot (5) undivided.

The seventeen male offspring.—The variable black marking of the hind-wing was on the whole less heavily developed in the males than in those of any except Family 3.

The thirteen female offspring—entirely cenea forms.—All the thirteen specimens possess ochreous scales in spot (1), which however appears white to the naked eye in Nos. 23 and 26. Spot (1) is of a pronounced ochreous tint and (3) very faintly ochreous in Nos. 14, 17, 20 and 27. Spot (1) extends downwards and outwards, in the direction of the pattern of *hippocoon*, etc., in Nos. 14, 17, 19 and 20 and very slightly in No. 9. A slight ochreous linear mark near the basal end of the inner margin of the fore-wing also tending in the direction of *hippocoon*, etc., is seen in Nos. 1, 14, 17, 19, 20 and 27. Spot (5) is divided in Nos. 9, 17 and, on the right side, 23 : it is nearly divided in No. 5.

Relation between the male offspring in the six Families.—The increasing heaviness of the black hind-wing band is shown by the letters A—D in the table on p. 429. It must be borne in mind that there is a considerable interval between stages C and D, but that the other intervals are small. In all six families the pronounced serration of the inner border of the fore-wing black margin is seen in a considerable proportion of the males, and quite as often in the more heavily marked as in the less heavily marked individuals. Indeed upon the whole it appeared to be slightly more characteristic of the latter.

Hereditary tendencies in the details of the mimetic pattern.—A comparison of the mimetic forms with one another in each family and with those of the other families indicates the ample nature of the variational material by which the mimetic pattern has been and could be again adjusted to the details of the patterns presented by the models. The condition of three elements in the pattern of the fore-wing upper surface of the *cenea* offspring, and of

one in the *hippocoon* and *trophonius* offspring of the six families, is shown below in a tabular form. When the character is present on right or left side only it is counted as $\frac{1}{2}$, and if on one side of two individuals as 1.

SPOT (5) IN ♀ PAREN".	FEMALE OFFSPRING IN CONDITION FOR STUDY.	NUMBER EX-AMINED.	(5) DIVIDED IN.	(4*a*) PRESENT IN.	(2*a*) PRESENT IN.
Family 1. *cenea:* divided.	*cenea*	6	1	0	0
	hippocoon	2	1	—	—
Family 2. *trophonius:* divided.	*cenea*	2	0	1	0
Family 3. *trophonius:* escaped.	*cenea*	4	1	0	0
	trophonius	1	0	—	—
Family 4. *hippocoon:* undivided.	*cenea*	8	3	$1\frac{1}{2}$	0
	hippocoon	3	1	—	—
	trophonius	3	0	—	—
Family 5. *cenea:* divided.	*cenea*	14	9	5	2
	hippocoon	1	1	—	—
Family 6. *hippocoon:* undivided.	*cenea*	13	$3\frac{1}{2}$*	2	1

* Including No. 5 in which the spot is nearly divided.

A comparison of Family 5 with the others at once shows that there are certainly hereditary tendencies in details of the pattern. If the pattern of the model became more nearly approached by the division of spot (5) in the mimic, or by the addition of such elements as (4*a*) or (2*a*), the above table supports the conclusion that selection would quickly confer these characters upon the *cenea* form of female. It is equally clear that these hereditary tendencies exist in the most varied combinations. Thus referring again to Plate XXIV, it is obvious that the addition of (4*a*) and (2*a*) tends to occur when the normal spots are well developed, but (4*a*) is present in Fig. 14,

where they are small. So also with the submarginal spots which vary with but also independently of the chief spots (1)–(5). Thus the apical spot (δ) may be absent when (1)–(5) are small, as in Fig. 14, or when they are large, as in Fig. 19. But upon the whole it tends to be well developed when (1)–(5) are also well developed, as in Figs. 15–18, etc.

This kaleidoscopic combination of the various elements in a pattern, added to the existence of undoubted hereditary tendencies in the associations as well as in the individual components, enables us to understand how the complex detail of these mimetic patterns has been attained.

This most valuable and interesting material, which we owe to the skill and energy of Mr. G. F. Leigh, F.E.S., thus throws a flood of light upon two difficult and fascinating problems—the proportions of the mimetic forms to those of their particular models in each locality, and the more fundamental problem of the adjustment of the details of the mimetic patterns to those of the models.

Explanation of Plates XXIII, XXIV.

[*See Explanation facing the* Plates.]

XXI. *Mimetic North American species of the Genus* Limenitis (s. l.) *and their models.* By Edward B. Poulton, D.Sc., M.A., LL.D. (Princeton), F.R.S., etc., Hope Professor of Zoology in the University of Oxford, Fellow of Jesus College, Oxford.

[Read November 20th, 1907.]

Plate XXV.

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Introduction.

The mimetic species of the North American Nymphaline genus *Limenitis* (including *Basilarchia*) superficially resemble, in the east and north, as suggested by Doubleday (Gen. Diurn. Lep., ii, p. 275), models belonging to (1) the *Danainæ* and (2) the *Papilioninæ*: in the west (3) a Nymphaline model generally placed in the South American genus *Adelpha*, allied to *Limenitis*.

A species of *Limenitis*, in many respects relatively ancestral and probably resembling the form from which the mimics arose, still exists in the east, and another in the west. Hence the history of the transformation—probably in every case very recent—can be made out with exceptional clearness.

The subject will be treated in the order in which the models have been arranged above.

I desire to thank Dr. F. Du Cane Godman, F.R.S., for

kindly lending me the specimens represented in Figures 2 to 8 on Plate XXV, and the authorities of the British Museum of Natural History for the originals of Figures 1 and 10.

THE DANAINE INVASION OF THE NEW WORLD AND THE CONSEQUENT MODIFICATION OF NORTH AMERICAN SPECIES OF LIMENITIS.

One of the most interesting problems of mimicry and migration in butterflies is raised by the consideration of these North American Danaines. The genera to which they belong extend throughout the tropical New World, but, although represented by excessively abundant individuals, they enter into no synaposematic relations with any of the Neotropical combinations. They mimic nothing and nothing mimics them in tropical America. On the other hand, in North America they supply models for some of the very best examples of mimicry in the North temperate zone. Considering these facts, it is clear that a suggestion published by the present writer in 1901 is erroneous. *Anosia plexippus* (*archippus*, F.) cannot have had its ancestral home in South America or have invaded the northern belt from the immediate south. The argument founded on a supposed southern source is, however, unaffected and has so direct a bearing on a common hypothesis as to the origin of mimetic resemblances that I venture to quote it on the present occasion:—"In the New World the genus *Limenitis* is confined to the Nearctic Region with the exception of a single species, a form of the mimetic *L. astyanax* (Fabr.), which just enters the borders of Mexico. If butterfly colours and patterns are the expression of the direct influences of the environment, then it is clear that the indigenous non-mimetic species of *Limenitis* (*Basilarchia*) are an expression of Nearctic conditions, and according to the theory of External Causes, the invader from the South should have come to resemble them instead of drawing an ancient Nearctic species far away from the ancestral colours and patterns into a close superficial likeness to itself."* This argument is, as I have said, unaffected, because the Danaine is clearly an invader, although not from South America.

* "Verhandl. d. V. Internat. Zool. Congr. z. Berlin." Jena, 1902, p. 171.

The argument may be briefly recapitulated as follows:—

The fact that the distasteful foreign species, invading temperate North America from a very different area, should not only maintain their characteristic original appearance under such different conditions, but should compel the ancestral residents in their new home to resemble them, is entirely inconsistent with an interpretation of mimicry based upon the supposed influences of locality (soil, food, climate, etc.).

In attempting to make out the past history of the North American Danaines, it is of paramount importance to ascertain their affinity with the Old World species; for it is admitted that their relationship to all other New World genera is remote. Rothschild and Jordan have recently stated that *Tasitia* is inseparable from the genus *Danaida* (*Limnas*) which contains the well-known *chrysippus*, L., and its forms.* I therefore wrote to my friend Dr. Karl Jordan, enquiring whether he had considered the affinity of these forms to the New World *Anosia* and the Old World *Salatura*. He kindly replied as follows:—"I think that *all* the tawny Danaids [*Limnas, Salatura, Tasitia, Anosia*] are *one* genus, with the exception of the large [*Anosia*] *plexippus*. This insect differs as larva in having only two pairs of filaments † and as imago in the cell of the hind-wing being very long. The differences given by Moore for *Limnas*, *Tasitia* and *Salatura* do not at all hold good, neither the shape of the wings nor the position of the veins being constant."

Accepting this conclusion, the name *Anosia plexippus*, L. (*archippus*, F.), will be retained in the present memoir, while *berenice*, Cr., and its form *strigosa*, Bates, will be placed in the genus *Danaida*. It is impossible to speak with certainty as to the Old World species which most nearly represent the invading ancestors of the North American Danaines. A safe conclusion can only be arrived at after a searching investigation into the structural details of many species. But there can be little doubt that *Danaida* (*Salatura*) *genutia*, Cr. (*plexippus*, L.), presents many of the features of this ancestor. Thus the white markings upon the hind-wing under surface of *D. berenice*

* "*Danaida chrysippus* cannot be generically separated from the American *gilippus* and *berenice*, *Limnas* being a synonym pure and simple of *Tasitia*." Nov. Zool., vol. x, Dec. 1903, p. 502.

† See, however, the note on p. 488.

are practically identical with those of *genutia*. The distribution of the latter also favours the same conclusion, for it extends far beyond the tropics into Western and Central China.

Anosia is the outcome of a much earlier invasion, allowing time for modification and the acquisition of characters of generic rank in the new home. *Danaida berenice* is the result of a far more recent immigration. The Old World parents of the two American forms were probably closely allied or may even have belonged to the same species at different periods of its history. There is strong evidence in the mimicry of these two genera by species of *Limenitis* (*Basilarchia*) that the relative periods of residence in North America were as they have been indicated above. Details will be supplied in later pages. It will be sufficient to point out here that the evolution of *L. archippus*, Cr. (*misippus*, F.), from the characteristic type of Holarctic *Limenitis* presented by its ancestor *L.* (*B.*) *arthemis*, Drury, has involved an entire change to a new and highly elaborate pattern on both surfaces,—a process which even the most ardent mutationist can hardly conceive to have been a rapid one,—especially when the mimetic pattern hits off so precisely the characteristic details of the model. *Danaida berenice* has however merely modified into resemblance with itself—a likeness attained by a few simple but perfectly effective changes—the mimic already fully formed under the influence of *Anosia*. In fact, distinct and evident details of the earlier mimicry of *L.* (*B.*) *archippus* still persist, and somewhat detract from the mimetic resemblance attained by its descendant, *floridensis*, Streck. (*eros*, Edwards).

The effects produced by both Danaine models upon the butterfly fauna of North America, combined with the absence of such effects in the tropical New World, support the conclusion that residence in the north has been far longer than in the south, and that the south was reached by way of the north. It is probable that the Old World ancestor of *Anosia* spread northward along the eastern borders of Asia, and entered America by way of the Aleutian Islands, and that its astonishing northern range dates back to the period of the invasion. The ancestor of *Danaida berenice* may have followed the same route during some temporary amelioration of climate, enabling this more tropical form to reach its present home in the New

World. At the northern boundary of the Neotropical Region—now running east and west from Mexico City to points on the Atlantic and Pacific coasts considerably further north—the southward migration of both Danaines was probably checked for a considerable period. Held back for a time at the limits of that crowded area, teeming with the species of the allied *Ithomiinæ*, they finally in comparatively recent times forced their way southward and spread through South America, even reaching, in the case of *Anosia*, the south temperate zone. All this has been so recent that only insignificant changes—probably subspecific—have occurred, and no mimetic or synaposematic relationship has been formed.*

The hypothesis set forth above has the one merit that it accounts for the facts, puzzling as many of them are. The phenomena in the northern zone are unique, and as for those of the tropics, there is no other case where *Danainæ* of such marked size and appearance range through a crowded area without producing any effect on any member of the Lepidopterous fauna, or without themselves being affected thereby. If a striking comparison be desired, no better instance can be selected than the three African species of the genus *Melinda* (*Tirumala*), the products of an invasion from the Oriental Region. Of these three species *T. formosa*, Godm., and *T. mercedonia*, Karsch, are mimicked respectively by *Papilio rex*, Oberth., and its form *mimeticus*, Rothsch., while *T. morgeni*, Honrath, is itself mimetic of the characteristic Ethiopian Danaine genus *Amauris*.

It is, perhaps, unnecessary to state that in speaking of this Danaine invasion of tropical America, I leave out of account the remarkable *Danainæ* forming the section *Lycorœini*. These are at once shown by their structural peculiarities no less than by their intimate association with the great synaposematic groups to be very ancient inhabitants of the Neotropical Region.

The evolution of Limenitis (Basilarchia) archippus, Cr. (misippus, F.), and its forms as mimics of the invading Danaines.

L. archippus is rightly considered by S. H. Scudder as the most striking example of mimicry in temperate North

* It is however possible that a large Peruvian form of *Actinote thalia*, L. (or *anteas*, Dbl., Hew., if these two forms can be kept distinct), is an incipient mimic of *Anosia*.

America (" Butterflies of the Eastern United States and Canada," Cambridge, Mass., 1889, p. 718). It is, indeed, one of the most striking in the world. Before describing the evolution of its pattern from that of the ancestral *L. arthemis* it will be convenient to compare the distribution, habits, etc., of the two species.

Limenitis archippus, Cr.—Scudder states that this species ranges nearly all over the United States as far west as the Sierra Nevada, and, in Oregon and British Colombia, to the Pacific. It is however rare in the west, and unknown in Colorado, Arizona and New Mexico. It extends from Hudson Bay in the north to the Gulf of Mexico in the south. It is thus " found over very nearly the same area as *Anosia* " (l. c., p. 278).

Scudder describes its flight as " rather leisurely and sailing " (l. c., p. 277). It frequents " open country in fields and meadows, especially in low ground." Comparing its relative numbers with those of its parent *arthemis* and the sister species *astyanax*, Scudder states that *archippus* is " almost universally more numerous in individuals than the others " (l. c., p. 266). *Archippus* always appears to have two broods where the other two species usually have one.

The food-plants of the larva are willow and poplar, although many other plants are also recorded.

Limenitis arthemis, Drury.—Scudder speaks of this as a Canadian species *par excellence*, ranging over the whole width of Canada east of the Rockies, and far north to an unknown distance. It is also abundant in the north-eastern States.

Scudder describes its sailing flight (p. 304), also stating that " it is very active, and has a rather short and rapid flight " (p. 303).

The earlier stages of the two eastern and northern mimetic species of *Limenitis* and their non-mimetic ancestor are, according to Scudder, only distinguished with difficulty (p. 254). *Arthemis* and *astyanax*, F., are, however, as we should expect, even more closely similar than *arthemis* and *archippus* (p. 255). The larva of *arthemis* feeds on a great variety of plants, including willow and hawthorn.

The evidence that Limenitis archippus occurs at the same time and place as its model.*

The following evidence (p. 455) bearing on the time and space relationships of *Limenitis archippus* and its Danaine model exists in the bionomic series of the Hope Department. The most perfect data were those obtained on August 5, 1897, when, with my kind friends Professor W. M. Wheeler (now of Harvard) and Professor S. Watasé, I had an excellent opportunity of witnessing the flight of many examples of both model and mimic on the same ground.

One of the specimens, a female, captured on August 6, 1897, had evidently been visiting the flowers of the food-plant of its model; for abundant Asclepiad pollen-masses are attached to its limbs.

The evolution of the mimetic pattern of L. archippus from that of the non-mimetic L. arthemis.

In the following interesting passage Scudder discusses the general principles by which, as we may believe, this remarkable transformation was effected:—

"It is to be presumed that the actual colors found in a mimicking butterfly are, with rare exceptions, such as existed somewhere in the ancestral form. In the case of our own mimicking Basilarchia, for example, whose orange ground tint is so totally at variance with the general color of the other normal members of the group, it will be observed that all the normal species possess some orange. Without this as a precedent fact, such perfect mimicry might perhaps never have arisen. Individuals among the normal species vary somewhat in this particular, so that

* Much time and effort have been expended, during many years, in the Hope Department, to induce naturalists in the field to collect evidence bearing on the coincidence in time and space and on the habits of mimetic species and their models, to breed the seasonal forms of butterflies and accurately to record the times of their appearance in nature. Many of the results of this special study have been published. So far as I am aware, systematic attempts of the kind have been made by no other institution. I am bound to assume that the editor of "The Entomologist's Record" is ignorant of facts well known to probably every other student of insects in this country. However this may be, any reader of that publication can judge for himself how far the statements and inferences on pp. 189, 190 of the July number are true or false.—E. B. P., July 27, 1908.

MODEL. *Anosia plexippus.*	MIMIC. *Limenitis archippus.*	LOCALITY.	CAPTOR AND DATE.
1	2 (with 2 *L. arthemis*)	W. Manitoba, Russell, July 6, 1897, about 1600 ft.	H. R. Smith. July 6, 1897.
2	3	W. Manitoba, about 1700 ft., 5 miles W. of Virden.	Miss Mary G. Holmes. July 5, 1898.
1	1	Ontario, Lake Simcoe, De Grassi Point.	E. M. Walker. July 29, 1899.
1	—	Toronto, Golf Links, 5 miles E. of city.	E. B. Poulton. Sept. 23, 1897.
—	1	Toronto, Rosedale.	E. B. Poulton. Aug. 25, 1897.
1 Aug. 19.	1 Aug. 27.	Northern Adirondacks, N.Y., Paul Smith's.	Rev. A. P. Hunt. 1903.
1 Aug. 17.	3 "Aug," Aug. 19 and 21	White Mountains, N.H., about 1800 ft., Colebrook, Parson's Farm.	Rev. A. P. Hunt. 1901.
5	2	Eastern States, probably Dublin, N.H.	Abbott H. Thayer. Probably Aug. 12, 1899.
3	5	Near Boston, Revere Beach.	Rev. A. P. Hunt. Aug. 2, 1901.
4 (including pair in cop.)	8	Chicago, waste land, S. of Jackson Park.	S. Watasé. W. M. Wheeler. E. B. Poulton. Aug. 5, 1897.
—	2	Chicago, E. of Lake Calumet.	W. M. Wheeler. E. B. Poulton. Aug. 6, 1897.
1	1	Kansas, Topeka, near Rock Island, R. R. Bridge.	C. L. Pribble. June 10, 1900.

it is easy to suppose that some of the original archippus with more orange than usual may have escaped capture on occasion from this cause. From such a small beginning, such as one may now see every year in B. astyanax, sprang doubtless the whole story, and we now find a butterfly which has for a ground color of both surfaces of the wings an orange which is the exact counterpart of that of Anosia plexippus; by reason of which in all probability it enjoys a freedom from molestation comparable to that attributed to plexippus, so that it ventures more into the open country than its allies, and thus gains a wider pasturage and surer subsistence" (l. c., p. 714).

The attempt will now be made to give an account of the changes in detail by which the mimetic pattern has been evolved from the entirely different pattern of the non-mimetic ancestor. The changes are somewhat more complex and probably more important upon the under surface which will therefore be considered first.

a. *Hind-wing Under Surface of Limenitis archippus.*—The black outer border to the white discal band of the hind wing of *arthemis* persists in *archippus*, but is much displaced inwards as compared with its ancestor. The reason of this is evident. The character in *arthemis* which initiated the mimicry of *Anosia* is the submarginal row of reddish spots, commonly found in the hind-wing, more rarely in the fore. The enlargement of these, as well as of the black-and-white-marked margin (also in mimicry of *Anosia*), has involved the shifting inwards of the black outer border of the white band. In many specimens of *archippus*, traces of the white band of *arthemis* may still be found for a greater or less distance along the inner edge of the black discal line. This vestige is especially often retained along the costal half of the line: it is occasionally well developed along its whole length. The original submarginal red spots are still recognizable between the discal line and the margin, being easily distinguishable by their deeper richer tint from the pale ground colour of the wing.

The black margin has become heavier, the double row of blue crescentic spots larger and whiter, but a faded trace of the original blue tint of *arthemis* can still be made out in the spots of the inner row, and remains distinct in the outer.

The basal red patches have vanished, but the pale blue

marks in and on the costal side of the base of the cell are retained, and, lightened in tint, represent the two more conspicuous white spots occupying nearly the same position in *Anosia*.

These changes, together with the transformation of a dark chocolate-brown ground-colour into a pale yellowish tint are the means by which the hind-wing under surface of the non-mimetic ancestral *arthemis* has become that of its beautifully-mimetic descendant, *archippus*.

b. *Fore-wing Under Surface of Limenitis archippus.*—The changes on the under surface of the fore-wing must now be considered. In *arthemis* the angulated black line, bordering the outer edge of the white discal band, runs from the costa to the anal angle of the wing. In *archippus* its anal extremity has been shifted upwards until it now joins the hind margin about at the junction of its middle and anal thirds. Rendered far more conspicuous against the ground-colour, greatly expanded at its costal end and there enclosing from two to four white spots, vestiges of the outer part of the white band, the marking now adds greatly to the mimetic resemblance, by its likeness to the subapical pale-spotted black band of *Anosia*. A further trace of the white band is generally seen on the costa itself, here often persisting for a distance equal to the normal width of the marking in *arthemis*. This character has also probably been retained because of its resemblance to the costal white markings of *Anosia*.

The two deep reddish patches in the cell of *arthemis* have disappeared in *archippus*, converted, with the ground-colour around them, into a fulvous tint considerably darker, as in the model, than that of the hind-wing and the apical region of the fore. Between these red patches in *arthemis* is a variable bluish triangular mark often pupilled with white and often surrounded by a black border. Other even more variable markings of the same kind are seen in the base of the cell. Although the red spots have disappeared in *archippus* the outer of these pale marks is, together with its black margin, almost always retained of full size but whiter than in *arthemis*. A trace of the basal mark or marks is also generally to be seen, sometimes only in the form of the black margin including a few pale bluish scales. This feature persists in a more complete state in the female specimens I have had the opportunity of examining. The outermost triangular pale mark, in spite

of its far more isolated position, probably represents a white spot, also triangular in shape, near the end of the cell in *Anosia*.

The marginal pattern is as in the hind-wing save that the apical white spots of the innermost series lose the crescentic shape and become squarish. The changes which have occurred in the subapical white spots of *arthemis* are peculiarly interesting. In *archippus*, only the costal spot and the second minute spot, generally a mere point, remain distinct and clear as in the ancestral form. The others —one to three in number— have become continuous with and contribute to form the triangular subapical pale yellowish patch which, in both mimic and model, is of the same tint as the ground-colour of the hind-wing. In the *Limenitis*, however, the outer (hind-marginal) part of this pale patch exhibits, as in the hind-wing, by a deeper tint, a distinct vestige of the reddish submarginal spots of *arthemis*. The single distinct costal white spot and minute second spot already referred to, appear to represent the extremity of a sickle-like curve within the apical angle of the fore-wing. All other parts of this curve are made up of the innermost series of marginal white spots—the ones which have undergone the principal increase in size in *archippus*. The effect is heightened by the special enlargement of the apical spot itself. Now when we turn to the model we find that the innermost series of marginal white spots does actually turn inwards sickle-like within the apex and that a close superficial resemblance has been attained in the mimic by the fusion of two separate elements. One of these has been preserved for the purpose out of an ancestral marking of which the remainder has been transformed in an entirely different direction.

The utilisation of the chief black and white markings of *arthemis* in the subapical region of the fore-wing of *archippus*, in order to promote the mimetic resemblance to *plexippus*, together with the value of the whitened marginal lunules of both wings is fully recognised by Scudder (l. c., p. 278).

c. *The Upper Surface of Limenitis archippus.*—The marginal band is much blacker and heavier looking than that of the under surface, in correspondence with the *Anosia* model. The markings in it consist only of the white sections of the fringe and the spots of the innermost series, the outer blue crescentic marks in the margin of *arthemis* having disappeared. The innermost crescents have become white and

in many individuals of *archippus* have lost their original form and gained a rounded shape. They often tend, as in the model, to be more strongly developed in the anal part of the series. Clear evidence of selection is seen in the relation between the degree of development of the black, white-marked marginal pattern in fore- and hind-wing of *arthemis* and *archippus* respectively. In *arthemis* this pattern is far more developed in the hind-wing than the fore, a condition reversed in *archippus* in accordance with the pattern of its model. A sickle-like curve is developed within the apex of the fore-wing in the same manner but not so fully as on the under surface.

The black outer border of the white discal band persists but is less heavy than on the under side. As on the latter surface it seriously interferes with the likeness to *Anosia* on the hind-wing, but enters into the mimetic pattern on the fore. Vestiges of the white discal band were not found on the upper surface of the hind-wing in any of the numerous specimens I have examined (although occurring in the form *hulsti*, Edw.); nor was the black band entirely wanting from any. A variety without this latter marking is however known and has been described as *pseudodorippus*, Strecker. The type of this form exists in Dr. W. J. Holland's collection ("Butterfly Book," New York, 1899, p. 185). On the fore-wing, vestiges of the white band persist and enter into the mimetic pattern, but they are far more reduced than on the under surface, in correspondence with the fact that many of the orange apical spots on the upper surface of the model are represented by white on its under surface.

The triangular pale spot in the cell of the fore-wing is usually represented on the upper surface by its black border only, but in a considerable proportion of individuals the white centre persists in a conspicuous form. In many individuals of the ancestral *arthemis* the same marking appears on the upper surface as a white point, generally very minute and often developed unequally on the two sides.

d. *The white spots on Body and Appendages of Limenitis archippus.*—There appears to be great variation in *arthemis* in the development of these pale spots and markings, but there is no doubt about their great increase in size and brilliancy in *archippus* and conversely their great reduction in *astyanax*. Pale spots corresponding to the brilliant white marks of *archippus* are always to be found in some

individuals of *arthemis*. This development in the mimic of course corresponds to the conspicuous body and leg pattern of the Danaine model.

Limenitis archippus, f. hulsti, Edw., a better mimic than archippus itself.—In this Arizona and Utah form, as described and figured by Dr. W. J. Holland ("Butterfly Book," pp. 84, 185, Pl. VII, fig. 5), the black discal band on the hind-wing upper surface is evanescent, although distinct traces of the white band persist as a series of internervular spots. I have not had the opportunity of examining the under surface pattern. Dr. Holland states that the species occurs in Arizona with *Danaida berenice* and its form *strigosa*, Bates, and that it more closely resembles the latter. It is not unlikely that the vestiges of the white band on the hind-wings may, when the insect is on the wing, conduce towards a general likeness to the pale-streaked hind-wings of *strigosa*. Dr. Holland's figure indicates that, in the reduction of the subapical black of the fore-wing and the appearance of the associated white spots, *hulsti* has been modified from mimicry of the *Anosia* into resemblance to *Danaida*. Dr. Holland also draws attention to the dull tint of its ground colour as compared with *Limenitis archippus*, another change in the same direction.

Limenitis archippus, f. floridensis, Strecker (eros, Edwards), a mimic of Danaida berenice.

This example of mimicry is nearly as well known as that of *archippus* for *Anosia* (see e. g. Scudder, l. c., p. 718). At the same time, so far as I am aware no attempt has been made to compare the details of the resemblance in the two mimics in relation to the patterns of their respective models.

That *floridensis*, Streck., is a modification of *archippus*, under the influence of a second Danaine model (*berenice*), and is not the result of an independent evolution from *arthemis*, is at once evident from the persistence in it of features which are truly mimetic in *archippus* but tend to interfere with the resemblance to the existing Danaine model. Such features are seen on the upper surface, in the heavily blackened veins, and the large black triangular subapical markings on the fore-wing, as well as in the corresponding markings on the under surface. These features are, however, greatly obscured by the deepening of the ground colour into a dark mahogany-brown, like

that of the Danaine model. For the same reason the black margin is wider on both surfaces than in *archippus*. On the upper surface the white spots in the margin are much reduced and the white sections of the fringe slightly so, while on the under these markings remain conspicuous and distinct, much as in *archippus*. The sickle-like curve of white spots is seen at the apex of the fore-wing in *berenice*, and this feature is represented in *floridensis* in the same manner as in *archippus*. On the under surface the hind-wing of the Danaine is strongly veined so that the original mimetic feature of *archippus* holds good for the new model. This is not the case in the fore-wing where it detracts from the resemblance. The darkening of the ground colour of the under surface of *floridensis* is especially remarkable because here the more ancestral mimic had acquired so pale a tint, in mimicry of *Anosia* which has an under side far paler than its upper. In *berenice*, on the other hand, the tints of upper and under surface are approximately the same. Against this dark ground all the white markings stand out far more prominently in both model and mimic than in *Anosia* and *archippus*. The basal costal light mark of the fore-wing under surface is more uniformly distinct in the few specimens of *floridensis* I have seen than in those of *archippus*; and the white spots bordering the black discal line of the hind-wing under surface are also more developed and certainly more distinct, being in fact often given a clear outline by means of a black margin on their inner edges. Here we have evidently the emphasis and in a sense the re-call of a vanishing character in consequence of the conspicuous spots around the end of the cell in the hind-wing under side of the new model, *berenice*.

Scudder describes the form *floridensis* (*eros*) as ranging into the Mississippi valley and Dakota, far beyond the limits of its Danaine model. It would be very interesting to know the proportionate numbers of such specimens and to compare them with those from Florida, and ascertain whether the mimetic resemblance is in any way affected. Hitherto I have only had the opportunity of examining specimens from Florida.

In addition to the differences in pattern which distinguish *floridensis* from *archippus*, Dr. W. J. Holland states that the former is generally the larger (l. c., p. 186), and this is the case with the specimens I have studied.

THE PAPILIONINE MODELS OF LIMENITIS ASTYANAX.

Before considering the evolution of *astyanax* from *arthemis* it is expedient to deal with the models, which in this case are Papilionine and not Danaine.

The late Erich Haase ("Researches on Mimicry," part ii, Stuttgart, 1896, English translation) discovered the wide extent of mimicry within the *Papilioninæ*, showing that the section to which he gave the name of *Pharmacophagus* tended to supply models for his two other sections of the *Papilioninæ*,—*Papilio* (of which *machaon*, L., may be taken as a type) and *Cosmodesmus* (of which *podalirius*, L., may be taken as a type). He showed that this is true of both areas inhabited by *Pharmacophagus*—the New World, and, in the Old, the Australian and Oriental Regions, and the parts of the Palæarctic adjoining the latter. Outside these areas *Pharmacophagus* is only represented by the single species *antenor*, Drury, of Madagascar. Rothschild and Jordan in their recent exhaustive and admirable monograph on the American Papilios (Nov. Zool., xiii, 1906, p. 411–752) entirely confirm Haase's triple division of the *Papilioninæ* and show the numerous mistakes that have been made by systematists in inferring relationship from the superficial resemblances due to mimicry.

Haase failed, however, to appreciate the true nature of some of these mimetic associations because of his imperfect recognition of the scope of the Müllerian principle. He failed to do so in the case of the models of *astyanax*. As in other examples, Haase regarded the distasteful Central and North American "*Aristolochia* Swallowtail" (to use Rothschild and Jordan's term), *Pharmacophagus philenor*, L., as the central model round which were clustered species of his section "*Papilio*" as well as the Nymphalines, *Limenitis astyanax* and the female of *Argynnis* (*Semnopsyche*) *diana*, Cr.*

But the resemblance of these two Nymphalines to the primary model *philenor* is so poor that the suggestion is

* The mimetic resemblance of the dark southern ♀ form of *Papilio glaucus* (*turnus*) to *P. philenor* is also mentioned by A. R. Wallace ("Darwinism," London, 1889, p. 248) and Weismann ("The Evolution Theory," 1904, English translation, i, pp. 110, 111). Wallace also (l. c.) speaks of the likeness of *Limenitis ursula* (*astyanax*) to *philenor*.

unconvincing, and most naturalists will agree with Scudder in his hesitation in accepting it. At the same time, Scudder points out that the female *Argynnis* is an undoubted mimic of the *Limenitis*, but he, also failing to recognise the scope of the Müllerian principle, was only puzzled by the fact.

In the following pages it will be argued that *philenor* is the central primary model mimicked by both sexes of *Papilio troilus*, L., by the female and on the under surface by the male of *P. asterius*, Cr., and by the dark female form (*turnus*, L.) of *P. glaucus*, L., but that strong secondary resemblances exist between these three mimics, rendering them far more like each other than they are to the primary model; that the *Limenitis* is a secondary mimic of these three mimics, and the female *Argynnis* a tertiary mimic, perhaps a Batesian mimic, of the *Limenitis*.

The Geographical distribution of Papilio (Pharmacophagus) philenor and its primary, secondary and tertiary mimics.

The distribution of the *Papilioninæ* is taken from Rothschild and Jordan's account, that of the *Nymphalinæ* from Scudder's.

Papilio philenor, L.

Distribution. Mexico and the United States, except the central district from Colorado northwards; in Southern Canada and New England as a straggler.

In the subspecies *orsua*, Rothsch. and Jord., from the Tres Marias Islands, the tail of the hind-wing is represented by a tooth-like projection and the glossy area on the hind-wing upper surface is more extensive and more brilliant.

The larvæ of *philenor* are gregarious when young and semi-gregarious later in life (Scudder, p. 1248–9). The perfect insect is very tenacious of life, and Edwards states that it has a strong and disagreeable scent.

The three Papilionine mimics are placed by Rothschild and Jordan in three different groups of the section "*Papilio*," Haase ("Fluted Swallowtails," Rothsch. and Jord.).

V. Machaon Group.

60 c. *P. polyxenes asterius*, Cram.

South and north, from Honduras to Canada: west and east, from Arizona and the Mississippi basin to the Atlantic. Females mimetic throughout the range. Males mimetic on under surface, but non-mimetic on upper except the form *ampliata*, Ménétr., common at Guerrero, Mexico. Intermediates between *ampliata* and the males with non-mimetic upper surface are also common in the same locality.

60 a. *P. polyxenes americus*, Kollar, from N. Peru to Colombia and Venezuela, also has a dark form of both sexes, *melasina*, Rothsch. and Jord., with all inter-gradations between it and the light type form. The special mimetic features of the female *asterius* are not developed in this dark form, which is of great interest in helping us to understand the evolution of the northern mimic from a comparatively simple melanic variety.

The larva of *asterius* is said to resemble that of *Anosia plexippus* (Scudder, l. c., p. 747).

VIa. Glaucus Group.

In Rothschild and Jordan's memoir two consecutive groups, of which this is the second, are both accidentally numbered VI. I have therefore called this VIa.

79 a. *P. glaucus glaucus*, L.

Atlantic district, from Florida to New England, and westward to Mississippi basin. The female form *glaucus* resembling the male is the ordinary one in the northern districts, while the mimetic form *turnus* is commoner than it in the southern. Intermediates occur but are rare.

79 b. *P. glaucus canadensis*, Rothsch. and Jord.

Newfoundland, Anticosti, New Brunswick, Canada to the north of British Columbia and Alaska. The females resemble the males, and mimetic forms are unknown in this subspecies, and the other species of the group.

VII. Troilus Group.

Allied to the highly mimetic Anchisiades Group, with gregarious larvæ.

Contains only two species, of which one is mimetic and the other probably non-mimetic, although incipient mimicry is possible on the under surface.

85 a. *P. troilus troilus*, L.

From Georgia to Canada: westward to Texas and the Mississippi plains: north-westward to N.W. territory of Canada.

85 b. *P. troilus texanus*, Ehrm.

Florida, in spite of the name. Probably a more primitive form in which the mimetic resemblance is less advanced than in 85 a.

86 a. *P. palamedes palamedes*, Drury.

Florida to Philadelphia, and westward to Mississippi plains.

86 b. *P. palamedes leontis*, Rothsch. and Jord.

A small form. Monterey, Mexico.

Limenitis astyanax.—The distribution is thus given by Scudder:—"It ranges from the Atlantic westward to the Mississippi Valley, and from the Gulf of Mexico northward to about the 43rd parallel of latitude." A closely allied species or more probably a form of the same species is recorded by Godman and Salvin from Mexico.

Argynnis (*Semnopsyche*) *diana*, Cr.—Scudder describes the distribution of this species as follows:—"An inhabitant of the hilly country of the south, following the Alleghanies, and a comparatively narrow belt westward at about the 38th parallel of latitude." How far westward it extends is unknown (p. 1801.)

The account given above shows that there is a very close coincidence between the distributional areas of the six species. When the area is comparatively restricted, as in the case of *A. diana*, it is still, as Scudder points out, altogether included within that of the species which its female most closely resembles, viz. *Limenitis astyanax*.

THE EVIDENCE THAT PAPILIO PHILENOR AND ITS MIMICS OCCUR AT THE SAME PLACE AND TIME. There is unfortunately at present far too little evidence on this subject. The small amount of material in the bionomic series of the Hope Department is tabulated below.

Philenor.	*Troïlus.*	*Asterius.*	*Glaucus.*	LOCALITY.	CAPTOR AND DATE.
1 ♂ 58th Street, near the University. 1 ♂ 58th Street, near Woodlawn Avenue.	1 ♀ 59th Street, near the University.	1 ♀ Jackson Park, the Island. July 28.	1 ♂ 59th Street, near Hotel del Prado.	Chicago.	E. B. Poulton. Aug. 10, 1897. Except *asterius.*
1 ♂ Aug. 1901.*	2 ♂ 1 ♀ Aug. 9. 1 ♂ Aug. 24.	1 ♀ Aug. 9.	—	Rutherford, N. J.	J. Cook. 1902.
3 ♂	—	1 ♂	—	Arizona, S. boundary of, Nogales.	R. C. L. Perkins. April, 1897.

* Probably a slip for 1902. The specimen has no original label upon it.

With regard to *Argynnis diana* I have no further information, but there is evidence that *L. astyanax* occurs with the Papilios. Thus Scudder states (p. 287) that it is persecuted by *Papilio asterius*. It is possible that, as in other cases which have been observed, the male *asterius* may pursue *astyanax* in mistake for its own female. Professor Bateson has informed me that he took *astyanax* with at least one of the above-named Papilios (probably *P. troilus*) and that he was greatly impressed with their resemblance in the field. In fact, if I understood him rightly, his general impression at the time was that he was observing a single species. Mr. J. C. Moulton has recently shown me six specimens of *astyanax* and one of the *turnus* female of *P. glaucus*, from a small collection of butterflies recently made at Sioux, Iowa, by Mr. C. H. Griffith.

THE RELATION OF THE TURNUS FEMALE OF PAPILIO GLAUCUS TO (1) THE PRIMARY MODEL, P. PHILENOR; (2) ITS CO-MIMICS IN THE PAPILIONINÆ.

At first sight the under surface of the dark southern mimetic female of *P. turnus* appears to be little more than that of a melanic variety in which the characteristic black markings of the fore-wing can be seen in deeper pigment than the ground colour. A remarkable feature is the persistence of a pale patch of ground colour just inside the end of the cell. In the non-mimetic females this very patch is more or less cut off by dark pigment from the rest of the pale ground colour, and it is an interesting fact that the isolated ground colour should remain pale while the rest has darkened. When the details of the mimetic resemblance are examined it is at once seen that the form *turnus* is far more than a mere melanic transformation of the female *glaucus*. There is a persistence of every element that aids in the superficial resemblance to the co-mimics and to the central model, *philenor*:—the marginal and submarginal series of yellow markings of the fore-wing, and the yellow marginal and deep orange submarginal series of the hind-wing, and between these two series the great intensification of bluish-green, margined internally with bright blue.

On the upper surface of *turnus* the adaptive nature of the transformation is even more evident. The blackness here is far more intense than on the under surface, and obliterates all the black markings of *glaucus*, any of which

would interfere with the mimetic resemblance to *philenor*. On the surface of the hind-wing the melanic transformation is accompanied by a great development of the iridescent blue scales, extending inwards into the cell, and also upwards to the costa and beyond into the neighbourhood of the anal angle of the fore-wing. In the few specimens I have had the opportunity of examining the colour of these scattered scales was bright blue and not bluish-green as in the submarginal region of the under surface. The yellow marginal and submarginal markings of the upper surface remain and contribute towards the resemblance to *philenor*, although the submarginal series is much nearer to the border of the wing than in the primary model. As regards the yellow colour, the *turnus* form is the least perfect of the three Papilionine mimics; for the submarginal spots of *troilus* (although yellow in the more ancestral non-mimetic *palamedes*) have gained a peculiar bluish-green colour in mimicry of *philenor*, while those of the female *asterius* have undergone a slight modification in the same direction.

In another very important element, however, the under surface of the *turnus* female is far nearer to *philenor* than are any of the other Papilionine mimics:—the existence of a single instead of a double row of bright orange-red submarginal spots on the hind-wing, although these are much closer to the margin of the wing than in the primary model. On the other hand, a second inner row of such spots is not present in the male or the ancestral female which resembles it. In the position of this inner row four wedge-shaped dull red marks are to be seen in the ancestral pattern, and the persistence of these, intensified by contrast with the dark ground colour, in the *turnus* form, is probably related to the presence of the inner row in *asterius* and *troilus*. They certainly interfere with the resemblance to *philenor*.

Each of the first four orange spots (counting from the costa) on the hind-wing under surface of *philenor* is edged with glistening white on the side towards the apical angle of the wing, the fifth is edged on both sides, the sixth towards the anal angle but not on the other side, while the seventh is not edged at all. In this respect the pattern of *turnus*, although by no means identical with *philenor*, approaches the latter more closely than do any of the other Papilionine mimics.

As regards the blue-edged green iridescence, the hind-wing under surface of *turnus* much resembles that of the female *asterius*. On the upper surface of the same wing the limitation of the submarginal blue iridescent scales by a black line (representing the inner boundary of the heavy black submarginal band of *glaucus*) also strongly suggests the female *asterius*, while the development of blue iridescence over the disc of the wing beyond this limit resembles *troilus*. The female of *asterius* is characterised by the absence of iridescence on the basal side of a black line corresponding to the limit above described. In place of the discal iridescence there usually appears on the hind-wing of the female *asterius* a more or less well-preserved vestige of the conspicuous yellow band of the male, extending, although in a less developed state, into the fore-wing. These features render the female *asterius* a less perfect mimic of *philenor* than are the other Papilios, although in the fore-wing of the male *troilus* a corresponding band is generally found, but in a far more vestigial condition. On the under side of the fore-wing in both sexes of this species as well as of the female *asterius*, this same band is far more evident, but undoubtedly concealed in the natural position of rest.

Secondary mimetic resemblances between the three Papilionine mimics of P. philenor.

The resemblance between these three mimics is stronger and more evident than might be inferred from the comparison of details contained in the last section. The dominant element in this secondary resemblance is the character of the blue and greenish tints on both surfaces. These in all the mimics present an appearance markedly different from that of the primary model, *philenor*, with its brilliant steely lustre. The remarkable likeness between the two rows of orange-red spots on the under side of the hind-wing in *asterius* and *troilus* is another important point, as also the fact that the female form *turnus* is prevented from being a mere melanic form of *glaucus* not only in details which resemble the primary model but in those which resemble its co-mimics. Upon the wing or even at rest from a little distance, all three mimetic Papilios would present the closest likeness to one another.

The larger of the two red spots near the anal angle of

the hind-wing upper surface in the *turnus* female is in nearly the same position as the one conspicuous spot of *asterius* and *troilus*, while at the apical angle of the same surface of the same wing, a large red spot appears in *turnus* and *troilus*. Red spots are not found in either position on the upper surface of *philenor*. These spots are certainly ancestral in the *turnus* female, inasmuch as they are present in the non-mimetic female form and the non-mimetic male of the same species, as well as in the allied non-mimetic species. For the same reason the black-pupilled red spot at the anal angle of *asterius* is ancestral. In *troilus*, on the other hand, both red spots are probably of recent origin on the upper surface, and have been developed in relation with the mimetic appearance. They are yellow in the ancestral *palamedes*. It is probable that their red colour in *troilus* has been developed in secondary mimicry of *asterius* and the *turnus* female form of *glaucus*. It is in accordance with this interpretation that the red spot at the anal angle of *troilus*, although without the black pupil, bears considerable superficial resemblance to that of *asterius*, and that the red spot at the apical angle is especially well developed in the female.

The comparison of these three mimetic forms also yields evidence of an approach towards the primary model, in which the different species have made different rates of progress, presumably determined in large part by the age of the mimetic resemblance.

Papilio troilus is evidently the oldest mimic. The mimetic likeness, extending to both sexes, has been derived from a very different appearance still preserved in *palamedes*. The suppression in *troilus* of the fifth orange-red spot of the inner row of *palamedes* is apparently an advance in the direction of the open loop of spots which is the prominent feature in the hind-wing under surface of *philenor*. Equally clear advance is seen in the bluish tint which the submarginal yellow spots of the upper surface of *palamedes* have gained in *troilus*.

Papilio polyxenes asterius is less perfect and presumably less old as a mimic than *troilus*. The mimetic resemblance is found on the under surface of both sexes, but on the upper the male, if a mimic at all, has only reached an early stage in the resemblance. The evolution of the two rows of definite orange-red spots out of the ill-defined elements found in the non-mimetic ancestors, was probably

effected under the influence of *troilus*. The ancestral yellow submarginal spots have darkened, but to a far less extent than in *troilus*.

Finally in the *turnus* form of the female *Papilio glaucus*, only found in a certain proportion of the females in the southern part of the range, we have the youngest of these mimics. The mimetic resemblance is in some respects less perfect than in the other two Papilios, but, as regards the red spots of the hind-wing under surface, it has been already shown that this form presents the closest likeness of the three.

The evolution of the mimetic pattern of Limenitis (Basilarchia) astyanax from that of the non-mimetic L. arthemis.

As regards the upper surface of *astyanax* the main and almost the only difference from *arthemis* consists in the disappearance of the white band of both wings, together with all but a trace of the subapical white markings of the fore-wing, and the spreading of an iridescent blue or greenish tint over and within the area formerly occupied by the band. Towards its inner limits the iridescent tint fades gradually into the dark ground colour of the wings. The iridescence is clearly an extension of the colouring seen in the marginal markings of *arthemis*. The dimorphism in tint—blue or greenish—is characteristic of the ancestral form no less than of its descendant. The reddish submarginal spots commonly seen on the hind wings of *arthemis* are rarer and far less developed in the specimens of *astyanax* which I have seen. The converse relationship holds in the fore-wings, where however the red spots are less developed in *astyanax* than in the hind-wing of *arthemis*.

Upon the under surface the changes are greater; for not only is there a similar disappearance in *astyanax* of the white markings of *arthemis*, but the whole ground colour has become of an iridescent dark greenish-brown, against which the reddish spots near the base of both wings and in their submarginal region, show up very prominently. Although from this cause far more conspicuous, the submarginal red spots of the hind-wing have become greatly reduced in *astyanax*, in correspondence with the increase in size of the crescentic black and

iridescent markings lying immediately external to them, and forming an elaborate marginal pattern. It is to be observed that in *arthemis* itself the tint of the ground colour of the under surface and consequently the degree of prominence of the reddish spots varies very greatly, and that therefore an important element in the change from the ancestral to this mimetic form was pre-existent in the parent species and ready for selection to seize upon.

Passing to a very different relationship between the two species, the flight of *astyanax* is described as similar to that of *arthemis*, but still more lofty and grand, more leisurely and sweeping. (Scudder, p. 287.)

L. ASTYANAX A SECONDARY MIMIC OF THE PAPILIO MIMICS OF PHILENOR.

Passing now to the mimetic relationships of *astyanax*, there can be no doubt that the iridescent blue or greenish of its upper surface resembles that of the Papilionine mimics rather than the primary *Pharmacophagus* model, although it approaches the brilliant steely lustre of the latter somewhat more closely than do the secondary mimics. Of all the three mimetic Papilios, *astyanax* chiefly resembles *troilus*, in which the submarginal crescentic spots are blue or greenish, instead of dull yellow as in the female *asterius*, or bright yellow as in the *turnus* female of *glaucus*. On the other hand, neglecting this feature, the blue varieties of *astyanax* would most closely resemble this latter form. These same blue iridescent examples of the *Limenitis* also resemble the females of *troilus*, in which the black ground colour is powdered with iridescent blue scales, forming a crescentic band inside the submarginal greenish spots. The greenish forms of *astyanax* similarly resemble the male *troilus* in which the iridescence is of a peculiar greenish-grey.

As regards the hind-wing under surface, the submarginal reddish spots of *astyanax* resemble those of the *turnus* female of *glaucus* less distantly than those of the other Papilios. But the resemblance to any of the three is in this respect only feeble. The basal reddish spots of *astyanax* may however, with the submarginal series, give something of the effect of the double row of the other two Papilios, or perhaps in the attitude of repose the basal and submarginal reddish spots of the *Limenitis* may be

to some extent joined up by those of the fore-wing under surface, forming a loop roughly suggestive of *philenor*.

Scudder regards *astyanax* as a very weak and perhaps incipient mimic of *Papilio* (*Laertias*) *philenor* (p. 287). Had the conception of secondary mimicry been before him, Scudder would have recognised that, although *astyanax* is, as he states, but a poor mimic of the primary model, *philenor*, it bears a considerable superficial likeness to the three Papilionine mimics of this species.

Transition between Arthemis and Astyanax.—The intermediate form *proserpina* is considered by Scudder (l. c., p. 289) to be a hybrid between *arthemis* and *astyanax*. In support of this conclusion he brings forward strong evidence based on distribution. *Proserpina* is found in a narrow belt across the eastern third of the continent, this belt coinciding with the southern boundary of *arthemis* and the northern of *astyanax*. Along this line it is known to occur at many points. *Proserpina* tends itself to vary in the direction of *arthemis* to the north and of *astyanax* to the south. The fact that Edwards bred *arthemis* and *proserpina* from the eggs of the latter is consistent with the view that the parent was a heterozygote (hybrid), whose offspring were yielding parent forms and heterozygotes, perhaps in Mendelian proportions.

In the collection of the British Museum *astyanax* and *proserpina* are regarded as forms or subspecies of *arthemis*, the form *lamina* of the latter supplying the connecting link.

Transition between Astyanax and Archippus.—Hybrids between these two forms are considered probable by Scudder (l. c., p. 283). Thus he quotes Meade (Can. Ent. iv, p. 217) "who found an astyanax on whose upper surface the blue was supplanted by fulvous 'except in the marginal lunules, which are white with a faint bluish tinge.'" He also refers to Grey (*Ibid.* xi, 17) for "a melanitic form of disippus [archippus] with all the markings of ursula [astyanax] on the under surface." Professor Bateson has kindly called my attention to further notes on such intermediates, with figures, in "Psyche" (1904, Feb., and 1907, Oct.).

It is therefore probable that occasional interbreeding takes place between *astyanax* and *archippus*, and that

hybrid offspring are produced. If this be so it would constitute further evidence of the close affinity between these three forms, and of the recent operations of the selective processes by which the two mimics have been derived from their non-mimetic ancestor.

Argynnis (Semnopsyche) diana (female) a tertiary mimic of Limenitis astyanax.—This interesting case of mimicry was, so far as I am aware, first suggested by Scudder, who was much puzzled by it. This distinguished authority remarks concerning *diana* that although it belongs to a group remarkable for resemblance between the sexes, its sexes are more strongly contrasted than those of perhaps any other butterfly in North America. "This difference, as we have pointed out in the body of this work, is a clear case of parastatic mimicry, the mimicry affecting the female only (as most in need of such protection), and is the more surprising since the butterfly mimicked belongs to the only genus in our fauna, where, in other species, parastatic mimicry of a Euploeid butterfly occurs. If a butterfly of the genus Basilarchia needs protection and gains it by mimicry of Anosia or Tasitia, why should Semnopsyche take to imitating a normal Basilarchia? That it does closely resemble it any one can see, and the following passage from Edwards, writing of the discovery of the female, may be taken in evidence: 'While breaking my way through a dense thicket of [iron-weed], hoping to find another diana [male], I came suddenly upon a large black and blue butterfly, feeding so quietly as to allow me to stand near it some seconds and watch its motions. It seemed to be a new species of Limenitis [Basilarchia], allied to ursula [astyanax], which it resembled in color.' It may also be pointed out that its range is altogether included within that of Basilarchia astyanax" (l. c., p. 1802). Although the obvious interpretation of this interesting resemblance on the probable hypothesis that *Limenitis* (*Basilarchia*) is a distasteful genus and its mimicry of *Anosia* Müllerian, seems to have escaped Scudder in this passage and on p. 718, he elsewhere suggests (on p. 266) that *astyanax* may be specially protected:—"It is indeed possible that one of the normally colored species of Basilarchia, one that has least conspicuously contrasted colors, though resplendent with blue and green, is specially protected by the various

other devices we have recounted; for certainly it is itself mimicked by one sex of a butterfly of another very distinct group, viz. Semnopsyche diana."

The female of *A. diana* is only mimetic of *astyanax* on the upper surface. There is, however, far less sheen about the blue tint of *diana*, and in this respect it approaches the *Papilio* mimics of *philenor* more closely than it does *astyanax*, while the *Argynnis* is itself further removed from the primary model than any of the other mimics. Scudder speaks of the uniformity between the sexes of the group to which *diana* belongs; but Dr. F. A. Dixey has shown (Trans. Ent. Soc. Lond., 1890, pp. 89–129) that the females of *Argynnis* often tend to be dark, and he points to *A. paphia* as a well-known example of a species with a dark female form,—*valezina*. He gives strong reasons for the belief that such dark forms are ancestral, and that among them the female of *diana* is especially primitive.

It is a probable hypothesis that the recent evolution of *L. astyanax* provided this ancestral form with a model which it could approach by small and easy steps of variation. In this way it is possible to explain the appearance of the only character which, in Dr. Dixey's opinion, "is really peculiar to *A. diana* among its relatives . . . . [viz.] the large expanse of blue ground colour . . ." which Dr. Dixey admits to be "like the corresponding feature in *B. astyanax* and *L. philenor*" (l. c., p. 106, footnote).

LIMENITIS (ADELPHA) CALIFORNICA, THE NYMPHALINE MODEL OF LIMENITIS LORQUINI.

The dominant genus *Adelpha* is the close ally and tropical American representative of the Holarctic and Oriental *Limenitis* (s. l.). *Chlorippe*, as employed by Godman and Salvin, is similarly the Neotropical representative and near ally of *Apatura*. The females of certain Palæarctic Apaturas such as our own *A. iris*, L., are probably rough mimics upon the upper surface of the black white-marked species of *Limenitis*, such as *L. sibylla*, L. I have found in the Sierra Guadarrama, Spain, *Apatura iris*, L., flying with *L. camilla*, Wien. Verz., and closely resembling it upon the wing. The males of these species with their beautiful

blue iridescence are far less perfect mimics. Similarly in the Neotropical Region many species of *Chlorippe* have brilliantly iridescent blue males, while the females are beautifully mimetic of Adelphas. In other species both sexes are mimetic of the same genus. These Chlorippes differ from the Apaturas in the much greater brilliancy of the males and the far closer mimicry in the females. Nor are they altogether restricted to the *Adelpha* models; for the female of *C. zunilda*, Godt., is a mimic of such a *Callicore* as *candrena*, Godt. As in *Apatura*, the mimetic resemblance of *Chlorippe* is confined to the upper surface.

The powerful genus *Adelpha*, with over 70 species, of which 31 extend into Central America, forms a homogeneous tropical group, at once distinguished by the hairiness of the eyes in front from the allied *Limenitis* of the northern belt. A single species with smooth eyes, provisionally included in the genus by Godman and Salvin, is not only removed from the other Adelphas by this feature, but also by its distribution; for its northern form, *A. californica*, Butl., ranges through California into Oregon, while the southern form, *bredowi*, Hübn., extending from Guatemala through Mexico into Arizona, reaches much further north than any other species of the genus. In the brief statements printed in the Proceedings of this Society (1907, pp. lxxvii, lxxix, lxxx) I have followed Godman and Salvin in provisionally retaining this remarkable form in the genus *Adelpha*, a position also assigned to it by Dr. W. J. Holland ("Butterfly Book," p. 187). Since these brief notes were prepared, Mr. G. A. K. Marshall has also studied its position, and I agree with him that *bredowi* and *californica* should be removed from the southern genus *Adelpha* and provisionally placed in the heterogeneous northern group, *Limenitis*, a position assigned to them by Scudder in 1875 (Bull. Buffalo Soc. N. Sc., Feb. 1875, p. 233). The hairy eyes appear to be the only consistent point of discrimination between *Adelpha* and the northern *Limenitis*, and even this distinction breaks down in the hairy-eyed Indian species of the latter group. The smooth eyes and the northern range support the removal of *bredowi* from *Adelpha*, while its very different male secondary organs are not alone sufficient ground for generic separation from *Limenitis* (*Najas*) *lorquini*. The evolutional point of view also supports the removal of *bredowi* and *californica* from *Adelpha*. Omitting these

two outlying forms, the whole genus is evidently the outcome of prolonged isolation and specific differentiation in the Neotropical Region ; while there are no reasons, except those founded on superficial resemblances of colour and pattern for supposing that *californica* and *bredowi* are the outcome of any such history. But in removing these two forms from *Adelpha* and transferring them to *Limenitis*, they lose a place in a definite and probably permanent genus and enter a heterogeneous and obviously provisional assemblage. Already the majority of the North American species have been split off as *Basilarchia*, while *lorquini*,* Boisd., has been included, with the European *populi*, in *Najas*, and the Chinese *albomaculata* separated as *Hypolimnesthes*. All these changes fall far short of what is required, viz. a careful revision of the *whole* assemblage of species included under the old *Limenitis*. Until this task is undertaken the creation of new isolated genera or subgenera may obscure rather than reveal the true relationships, and I therefore prefer to follow Godman and Salvin in provisionally placing the whole of the species under *Limenitis* in the broad sense, at the same time directing attention with these authorities to the composite nature of the group and the necessity for its thorough revision. I only differ from them by acting upon the doubt which they express, and removing a discordant element from *Adelpha*.

The southern form, *Limenitis bredowi*, Hübn., occurs in Guatemala, Mexico and Arizona, the northern form, *L. californica*, Butl., in California and Oregon. An example from each of these localities is figured on Plate XXV. *Californica* is also recorded by Dr. W. J. Holland (l. c., p. 188) from Nevada, and it would be extremely interesting to ascertain whether, on the S.E. borders of this State and of California, it interbreeds with and is transitional into *bredowi*, in Arizona. Dr. Holland says of the northern form—"In its habits and manner of flight it closely resembles the species of the genus *Basilarchia*" (l. c., pp. 187–8). And of the larval stage the same authority writes (p. 187) :—"while in general resembling the caterpillars of the genus *Basilarchia*, the segments are adorned

* *Lorquini* was included, with the other N. American species, in *Basilarchia*, in Proc. Ent. Soc. Lond., 1907, pp. lxxvii, lxxix and lxxx, following the arrangement of Dr. W. J. Holland. By a printer's error which unfortunately escaped notice, "W" (for West) has been printed instead of N (for North) on p. lxxx.

with more branching spines and with short fleshy tubercles giving rise to small clusters of hairs."

The southern Limenitis (Adelpha) bredowi a mimic of the Neotropical Adelphas.—Mr. Marshall has kindly compared the patterns of the extremely fine series of Adelphas in the British Museum with that of *L. bredowi*, and he finds that the latter most closely resembles, on both surfaces, *A. dyonysa*, Hew., while, as regards the upper side alone, *massilia*, Feld., *lerna*, Hew., and *fessonia*, Hew., would come into the same assemblage. The yellowish tint of the band of *bredowi*, so clearly mimicked by *lorquini*, is apparently not itself a result of mimetic resemblance to the Adelphas; for all the Central American species have the band pure white or bluish-white, with the exception of *A. pione*, Godm. and Salv., and one or two species like it —all very dissimilar from *bredowi*.

The Geographical distribution of the western species of Limenitis in N. America.

L. californica occurs, as has been already mentioned, in Oregon, California and Nevada, and the southern *L. bredowi* in Arizona, Mexico and Guatemala; *L. lorquini* occurs with *californica* in the three first-named States, but extends much further north along the Pacific coast into British Columbia and Vancouver's Island. *L. weidemeyeri*, Edw., is described as ranging from the Pacific slope eastward to Montana, Nebraska and New Mexico. The 18 specimens in the British Museum are from Colorado and Utah. Scudder gives the distribution as the Rocky Mountain Region from Montana to Colorado (Bull. Buffalo Soc. N. Sc., Feb. 1875, p. 233) and concludes from the dates of specimens captured on the Yellowstone Expedition in 1873 that its periods resemble those of *B. arthemis* (Proc. Bost. N. H. Soc., vol. xvii, 1874-5, Ent. notes, IV).

The early stages of *weidemeyeri*, according to Edwards, resemble those of *L. archippus* (Can. Ent., xxiv, p. 107). The larvæ of *lorquini* are described by Dr. G. Harrison Dyar (l. c., xxiii, p. 172).

Relation between the pattern of L. lorquini and that of the non-mimetic L. weidemeyeri.

In the above title I have not committed myself to the view that the pattern of *lorquini* has been evolved from

that of *weidemeyeri* in the manner that *archippus* and *astyanax* have sprung from *arthemis*. It is by no means improbable that, apart from the modifications which have produced a superficial resemblance to *californica*, the pattern of *lorquini* is more ancestral than that of the non-mimetic *weidemeyeri*.

On the upper surface the pattern of *lorquini* closely corresponds with that of *weidemeyeri*, but differs in the details described in the following section.

The apical area of the fore-wing is bright fulvous: the pale markings are cream-coloured instead of white: the whole discal band is placed nearer to the base of the wings, especially in the case of the hind: this band is also drawn out to a more pointed extremity towards the anal angle of the hind-wing: the constituent spots of the band, especially in the fore-wing, are more completely separated by strongly blackened veins.

An interesting feature possessed by certain individuals of both species is seen in the series of deep reddish spots, inconspicuous against the dark ground colour, placed along the outer border of the pale band in the hind-wing. These spots evidently represent the more prominent series commonly developed in *arthemis*. The complete series is occasionally quite distinct in *lorquini*; but as a rule the only conspicuous member is the spot at the anal angle of the hind-wing, where also a single spot of an outer series is often present. Of *weidemeyeri* I have had little material for careful study; but the red spots are faintly visible in one out of two specimens.

The inner edge of the white band of the fore-wing of *weidemeyeri* cuts the inner margin about opposite the centre of the white costal spot of the hind-wing, a spot much produced inwards towards the base of the wing as compared with the rest of the hind-wing series, as may be seen in Plate XXV, fig. 10 (in Fig. 1 the inward extension of the spot is concealed, especially on the left side, by the overlap of the fore-wing). In *lorquini*, which preserves the same general arrangement, the inner edge of the fore-wing band meets the costal spot of the hind-wing near its outer edge, thus forming a more pronounced step-like break than in *weidemeyeri*. The females of *lorquini* which I have had the opportunity of studying are in this respect in the condition of *weidemeyeri*. The white spot, which is almost invariably well developed in the fore-wing

cell of *lorquini*, is generally minute or altogether wanting in *weidemeyeri*. It is developed in the British Museum series of the latter species as follows:—Large on the upper surface in 1 male, of medium size in 1, minute in 7, and absent in 5 : of medium size in 2 females, very minute in 1, absent in 3.

Nearly the whole of the above points of distinction between the upper surface patterns of *weidemeyeri* and *lorquini* can be verified by the comparison of Figs. 1 and 10 with 6, 7, and 8, on Plate XXV. The example of *weidemeyeri* represented in Fig. 1 possesses an unusually well-developed spot in the fore-wing cell, while Fig. 10 represents an individual in which it is minute, especially so upon the left side. The relatively high development of this spot in *lorquini* is almost certainly ancestral, as is the subapical series of white spots in the fore-wing (less developed than in *weidemeyeri*) ; for both interfere with the mimetic resemblance to *californica* (compare Figs. 2 and 3 on the same Plate). The submarginal white spots, especially developed in the apical section of the fore-wing hind margin of *weidemeyeri*, have almost disappeared in *lorquini*. Faint traces can however generally be detected, as in Figs. 6, 7 and 8.

The difference in tint between the white band of *weidemeyeri* and the cream band of *lorquini*, *californica* and *bredowi* could not be shown by photography without detriment to other parts of the negative. Mr. A. Robinson, of the Oxford University Museum, got over the difficulty by colouring the parts which should have been cream with a wash of very dilute aniline colour in water. Plate XXV has been prepared from a print thus treated.

The under surface of *lorquini* differs from *weidemeyeri* in the strong development of a dark rich mahogany-brown, replacing more or less completely the bluish-grey tint of the basal half of the hind-wing and of the submarginal markings. So far as my experience goes this replacement is on the average carried much further in the examples of *lorquini* from Vancouver's Island.

In those individuals of *lorquini* in which the suppression of these pale markings is least pronounced, the inner row of submarginal lunules—bluish-grey in the hind-wing, white in the fore—is larger and more conspicuous than in *weidemeyeri*.

MIMETIC RESEMBLANCE STRONGER IN THE SOUTHERN EXAMPLES OF LORQUINI WHICH ARE GEOGRAPHICALLY COINCIDENT WITH CALIFORNICA.

The following features, described in the preceding section, promote a superficial resemblance of *lorquini* to *californica*:—

(1) The fulvous apical area of the fore-wing.
(2) The cream tint of the discal band crossing both wings.
(3) The fulvous marking at the anal angle of the hind-wing.

Of these features the last is so excessively variable and so often absent in both northern and southern examples, that very long series would be required in order to compare the average development in the two areas. This element in the mimetic resemblance is apparently incipient and imperfectly established.

The discal band is apparently paler in the northern *lorquini* than the southern. The difference, which is excessively slight, may be best seen when a series of individuals are compared; but I do not think that the conclusion can he regarded as safely established until a large number of fresh specimens have been carefully examined from this point of view.

As regards the most important feature in the mimetic resemblance—the fulvous apical area—there is undoubtedly a much greater average development in the examples of *lorquini* from California and Oregon (Figs. 7 and 8 respectively) than in those from British Columbia and Vancouver's Island (Fig. 6), entirely beyond the range of the model.

In many of the southern specimens of *lorquini* the fulvous apical patch extends inwards (as in Fig. 8 on Plate XXV) nearly as far as the outer border of the costal end of the discal band in the fore-wing. The colour is of a richer deeper shade than the bright tawny patch of *californica*.

On the under surface the development of the inner row of submarginal bluish-grey lunules into a festooned band in a large proportion of the examples of *lorquini* is probably caused by mimetic approach to *californica*. At any rate the marking is often a more conspicuous feature

in *lorquini* than in *weidemeyeri*. The study of its relative development in the southern part of the range would require a much larger number of specimens than I have as yet had the opportunity of seeing. There is however no doubt that the feature is generally suppressed in Vancouver's Island and that it is usually well developed in British Columbia.

The undoubted affinity between *californica* and *lorquini* may lead naturalists to conclude that their resemblance is due to relationship and not to mimetic approach. It is commonly forgotten that mimicry, being *independent* of affinity, occurs between forms of all degrees of relationship, the closest as well as the most remote. When the chief mimetic element in the pattern of *lorquini* is examined it is at once apparent that the likeness is superficial, and that the appearance is produced in a manner entirely different from that of the model. The orange patch on the fore-wing of *californica* is a clearly defined sub-apical and submarginal marking, roughly resembled in the mimic, *lorquini*, by the inward growth of a brown marginal marking (compare Figs. 2 and 3 with 6, 7 and 8 on Plate XXV). There can be little doubt also that the cream tint of *lorquini* is not ancestral, but due to recent modification of white markings like those of *weidemeyeri*, *arthemis* and many Palæarctic species of *Limenitis*. The average increase of mimetic likeness in the area occupied by the model confirms in the most convincing manner the conclusion that the resemblance is due to mimicry and not to affinity.

DIFFERENCES BETWEEN CALIFORNICA AND BREDOWI ARE SUCH AS TO PROMOTE A RESEMBLANCE BETWEEN THE NORTHERN FORM AND LORQUINI.

a. *The shape of the wings.*—The marked difference in the shape of the wings between the males of the northern *californica* and the southern *bredowi* is well seen by comparing Figs. 2 and 3 with 4, 5, and 9 on Plate XXV. This distinction, apparently, does not hold in the other sex; for the few southern females I have seen exhibited the proportions of the northern form. The difference was clearly explained, although without reference to the females, by A. G. Butler in his original description of *californica* (Proc. Zool. Soc. Lond., 1865, p. 486):—"the wings

are much more rounded than those of *H. Bredowii*, and are not produced at the end of the second median nervule." The more rounded shape of the hind-wings is also very clear in the northern form, those of the southern (Figs. 4, 5 and 9) being more triangular in shape, and the hind margin tending to form a straight line with that of the fore-wing to a greater extent than in *californica* (Figs. 2 and 3). In all these points by which the shape of *californica* is rendered different from that of *bredowi*, there is resemblance between it and *lorquini*.

b. *The fulvous mark at the anal angle of the hind-wings.*—It is unnecessary to describe this distinction in any detail; for the characteristic form of the marking is well shown in Figs. 4, 5 and 9, together with its diminution in the northern form (Figs. 2 and 3). It is barely seen in Fig. 3, although visible in the specimen itself. Fig. 2 however shows the marking distinctly and affords a fair comparison with the condition represented in the southern examples (Figs. 4, 5 and 9). Here too the divergence from the southern *bredowi* is coincident with resemblance between the northern form and *lorquini*.

c. *The step-like break in the band at the junction of fore- and hind-wings.*—As regards this feature *californica* is certainly far nearer than the southern *bredowi* to the appearance presented by *lorquini*. *Bredowi* approaches the condition, seen in many Adelphas, of a straight continuous band sweeping from fore-wing on to hind. Compare the representation of the southern form in Figs. 5 and 9, with those of the northern in Figs. 2 and 3, and the latter with *lorquini*, shown in Figs. 6, 7 and 8. The break on the inner margin of the band in the Arizona example represented in Fig. 4 is intermediate between the more northern *californica* and more southern *bredowi*. The difference between the right and left sides of Fig. 9 was probably caused by the "setting." The step-like break of *californica* is produced by the small size of the last pale spot on the inner margin of the fore-wing, as well as by the direction of the last spot but one, which is so placed that its inner border forms a considerable angle with that of the hind-wing band. If Figs. 4, 5 and 9 be compared in this respect with 2 and 3 it will be seen that the last spot of the southern form is much larger,* while

* This point of distinction between *californica* and *bredowi* was described by A. G. Butler in Proc. Zool. Soc. Lond., 1865, p. 465.

the last spot but one is twisted into a much closer coincidence with the inner border of the hind-wing band. As regards the position of the last spot but one, *lorquini* goes much further than *californica*, the direction of the inner border of the fore-wing spot coinciding with the outer border of the hind-wing band (Figs. 6–8).

Apart from the orientation of the last spot but one in the band of the fore-wing, the very characteristic hour-glass-like form seen in greater or less perfection in all the figures on Plate XXV is probably an ancestral feature. There appears to be no doubt that the indentation of the inner side of the spot tends to be obliterated and replaced by a straight contour in *bredowi* (compare Figs. 2 and 3 with 4, 5 and 9). In this respect the northern form is probably ancestral. At any rate an approach to *lorquini* in this feature is unlikely; for in *lorquini* itself the inner contour is less indented than in *californica*.

The fact that the break in *californica* approaches but does not equal that of *lorquini*, attaining in fact about the condition of *weidemeyeri* (see Figs. 1 and 10), supports the conclusion that in this respect *lorquini* acts as a model and *californica* as a mimic.

The step-like break, together with the more outward position of the spot below the end of the cell in *californica*, tends to give the band of the fore-wing an irregular zigzag W-like appearance, suggesting the form which is more fully and symmetrically attained in *lorquini*. The example of *bredowi*, represented in Fig. 9, is in the opposite condition, with a comparatively straight fore-wing band, while the specimens seen in Figs 4 and 5 are intermediate. The outward displacement of the spot below the cell of *californica* promotes this superficial resemblance to *lorquini*, in spite of the fact that the corresponding spot of the latter occupies a more inward position. It produces this effect by increasing the angulation of the irregular zigzag formed by the fore-wing band.

d. *The external border of the hind-wing band.*—The fifth spot (from the costa) of the hind-wing band of *californica* projects beyond the rest of the outer border to a greater extent than in *bredowi*, and thus disturbs the regular straight or slightly concave sweep which is so characteristic in the southern form. Although resembling no particular feature of *lorquini*, the difference probably promotes a general superficial resemblance to the distinctly convex

contour of the more interrupted hind-wing band of this species.

Slightly increased resemblance to the Adelpha pattern in the most southern examples of bredowi.

In one respect the upper surface of the most southern specimens of *bredowi*, from Guatemala, appears to show the influence of *Adelpha* more strongly than the more northern examples from Mexico and Arizona. In both the southern examples I have had the opportunity of studying there is a small fourth spot in the fore-wing band (counting from the costa), absent from the numerous more northern specimens of *bredowi* and *californica* which I have seen. This small spot is clearly shown, especially on the right side, in Plate XXV, fig. 5. It is considerably larger in a second Guatemalan specimen in the Hope Department. This feature tends to make the fore-wing band more continuous than in the specimens from further north. This spot is however generally represented on the under surface of *bredowi* from more northern parts of its range, and is often seen in the same position in *californica*.

Has reciprocal (Diaposematic) mimicry been established between californica and lorquini?

There is only one apparent means of escape from the conclusion that we are confronted with a striking example of Diaposematic resemblance between those two species. It may be held that *californica* possesses an ancestral pattern from which *bredowi* in the south has been modified by mimicry of the prevalent Adelphas. In certain respects this interpretation is probably correct. Thus the form of the wings in the female of the southern subspecies supports the conclusion that their similar form in both sexes of the northern subspecies is ancestral. But it would, I think, be a curious coincidence if all the details by which the northern *californica* differs from *bredowi* and superficially resembles another species, should be ancestral survivals unconnected with the presence of that other species—*lorquini*.

Are we to regard the evident *Adelpha*-like elements in the pattern of *californica*—only less strongly marked than those of *bredowi*—as ancestral or as the result of mimetic influence spreading with diminishing effect beyond the

range of the models? The latter seems to be a far more probable hypothesis; for we have a good parallel example in *lorquini* itself, where the mimetic influence has been shown to lessen as the mimic passes northwards out of the range of its model. At the same time it must be remembered that species of *Limenitis* (s. l.) with an *Adelpha*-like pattern exist in the Oriental Region; and it is a possible hypothesis that these species and *californica* represent the ancestor of the Neotropical Adelphas. The cream-colour of the band of *californica* is at any rate an ancestral feature, unconnected with mimicry of the *Adelphas*.

We may hope with some confidence that this fascinating but difficult problem may receive a final solution when the structural relationships of all the species of *Limenitis* and *Adelpha* in their broadest sense shall have been made out in detail. In the meantime, as I have said above, the origin of nearly the whole upper surface pattern of *californica* as the result of the spreading northward of an influence exerted by the genus *Adelpha* in the south, appears to be the safest provisional conclusion to adopt. The following facts seem to support it and at the same time to suggest that reciprocal mimicry of *lorquini* has also taken place.

The number of species of *Limenitis* in N. America points to an ancient existence in this portion of the Holarctic Belt. At the same time their mimetic relationships in the eastern section of the Continent have been shown to be extremely recent. The change in *lorquini* as it passes north of the range of its model (*californica*), suggests that its mimicry is also extremely recent. That the North American *Limenitis* are highly susceptible to mimetic influence is shown in the fact that they contribute such a high proportion of the butterfly mimics of the Continent, and that they furthermore produce the most divergent mimetic patterns. In the eastern section of the Continent this recent development of mimicry has been shown to correspond to a recent invasion of Danaine models and to the influence of Papilios—themselves mimics of recent date—exhibiting most beautiful examples of transition in the stages of developing mimicry. It is therefore extremely probable that the very recent mimetic pattern of *lorquini*—far more imperfect than that of any other mimicking *Limenitis* in America—also corresponds to the

recent appearance of an *Adelpha*-like model in a portion of its range. It is extremely difficult to believe that so imperfect a result would have been produced in a member of such a sensitive group if contact with the model had been prolonged.

Finally there is the fact that, as shown by Godman and Salvin, the southern form *bredowi* extends into Arizona much beyond the range of any true *Adelpha*, while examples from the most southern part of its range in Guatemala only exhibit, in the minute detail described on p. 485, an increased likeness to the Adelphas. The mimetic resemblance of *bredowi* is an established and stable product, but slightly increased by deepest penetration into the area of the models, maintained well beyond their northward limit, and only modified when the range of *lorquini* is entered in California.

The relationship of this interesting species to its *Adelpha* models indicates a marked susceptibility to influences of the kind, and supports the conclusion that the northern form has been reciprocally modified by the presence of its abundant mimic, *lorquini*.

CONCLUSIONS.

A. The Eastern Section of North America.

1. The Old World ancestor of the Danaine butterfly, *Anosia plexippus*, invaded the New World by way of the north, at a time sufficiently remote to permit of the acquisition of generic distinction.

2. The invader was mimicked by an indigenous species of *Limenitis*, closely similar to and probably identical with *L. arthemis*, which thus originated *L. archippus*.

3. A second closely allied Old World Danaine invaded the New World as *Danaida berenice*. This later invasion is so recent that the generic characters remain unchanged.

4. In Florida, the second Danaine intruder has modified the mimic of the earlier intruder into a superficial likeness to itself, thus producing the *floridensis* form of *L. archippus*.

5. The specially protected *Papilio* (*Pharmacophagus*) *philenor* is mimicked by three species of *Papilio*, the different stages to which the resemblance is carried indicating recent modification.

6. The three mimicking species of *Papilio—troilus, asterius* (female), and *glaucus* (female f.)—exhibit secondary mimicry of one another.

7. Secondary mimicry of these three Papilios has led to the evolution of *Limenitis astyanax* from *L. arthemis* at so recent a date that the two forms occasionally interbreed where they meet.

8. The female of *Argynnis diana* has been modified into a tertiary mimic of *L. astyanax.*

B. The Western Section of North America.

9. An ancestral northern Nymphaline butterfly belonging to the heterogeneous group "*Limenitis*" penetrated the area of the dominant Neotropical genus *Adelpha* and gained a superficial resemblance to its much-mimicked pattern.

10. The influence of *Adelpha* spread far beyond the range of the models into the northern subspecies *californica,* which in turn influenced, and has probably itself been reciprocally influenced by, *L. lorquini,* in California and Oregon.

11. The influence of *californica* upon *lorquini* spreads northward, with diminishing effect, beyond the range of the model, into British Columbia and Vancouver's Island.

12. Some of the ancestral features of *lorquini* are preserved in the non-mimetic species *weidemeyeri.*

Note.—A further study of the larvæ of *Danainæ* tends to throw doubt upon the validity of *Anosia* as a distinct genus. Two pairs of filaments are borne by the larva of *plexippus* and of *genutia,* probably its nearest ally in the Old World: three pairs are similarly characteristic of *berenice* and its probable representative, *chrysippus.*

Dr. Jordan, who has examined the male genitalia, kindly informs me that *chrysippus* and *berenice* are of the same type, while *genutia* and *plexippus* are of a second type. He agrees that *plexippus* cannot be generically separated from the other brown Danaines. E. B. Poulton, Dec. 16, 1908.

Explanation of Plate XXV.

[*See Explanation facing the* Plate.]

XXII. *Some bionomic notes on British East African butterflies,* by the Rev. K. St. Aubyn Rogers, M.A., F.E.S., of Wadham College, Oxford; *with further notes and descriptions* by Professor E. B. Poulton, D.Sc., M.A., F.R.S., etc.; *and an Appendix containing the description of new British East African forms,* by Roland Trimen, M.A., F.R.S., etc.

[Read December 4th, 1907.]

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Introduction.

[I have added to the following memoir many records of observations received in letters from the author. In most cases such notes are printed separately with the address and date of the letter in which each was contained. Occasionally the record had been cut out of the original letter and the address lost. In a few cases the statements in letters have been added to the memoir without any indication. My own notes, etc., are always clearly discriminated, and signed by my initials.

E. B. Poulton.]

These notes on the Bionomics of East African butterflies owe not merely their origin but their whole scope and character to Professor Poulton. The observations on which they are based were undertaken at his suggestion and under his guidance, and he has been good enough to work out the whole collection and to look over all the sheets of the paper, and send me the most valuable help and suggestions during its progress. In particular the tables of dates and localities of the several combinations are due entirely to him, and it is not too much to say that without his aid these notes could never have been compiled at all.

I have also to acknowledge the kind assistance of Dr. Dixey with regard to the *Pierinæ*. He has continually placed at my disposal his unique knowledge of this group,

and has given me every help in tracing out the relationships of the whole series.

I propose in the first place to convey some idea of the character and seasons of the various localities. These are—

(1) Mombasa and the Coast hills.
(2) Taveta and Kilimanjaro.
(3) Kikuyu.

(1) *Mombasa and the Coast hills.*

The climate of this area is typically tropical: the elevation hardly reaches 1000 ft., except in the case of single hills such as Mangea, which is 1600 ft. The air is moist and the temperature high throughout the whole year.

There are two wet seasons, lasting roughly during April–June and November–December, in the year, and the driest season is January–March, at which period the temperature is highest. It is rather singular that a family of *Belenois severina*, Cram., which was bred at Mombasa during this season belonged entirely to the wet season phase. In fact the seasonal forms of *Pierinæ* are most puzzling and unaccountable. For instance, all the specimens of *Pinacopteryx liliana*, Gr.-Sm., which I took at Taveta during the long dry season, belonged to the wet phase, whilst I took a good series of the dry phase at Mombasa at the beginning of July before the rains were over, in an exceptionally wet year.

This coast region is for the most part open cultivated country with extensive patches of woodland and some low forest. It is generally well watered at the southern end, of which Rabai is the centre. Further north it is much drier and becomes greatly parched at the end of the hot dry season; but I have not been able to do much collecting in this district. All along the coast the hills rise rapidly, leaving a narrow strip of littoral about 10 miles wide in most places. These hills do not reach a greater elevation than 1200 ft., except Mangea, which is 1600 ft. The greater part of my collecting has been done in these coast hills where the large black-and-white *Amauris*-centred combination is highly characteristic, and the important association centring round the larger red black-marked Acræas is also very much in evidence.

(2) *Taveta and Kilimanjaro.*

Although these are placed together as contiguous areas they differ entirely in climate.

Taveta has a comparatively small rainfall, averaging perhaps 30 inches, of which the larger portion falls between mid-March and mid-May. The rest of the year is an almost continuous dry season, broken only by a few heavy showers in November. The day temperature is high, rising well over 90° in the hot season, and the night temperature much lower, often falling below 70° even during the hottest period of the year, whilst in the cool season it sometimes sinks to 55°. The elevation is 2500 ft.

The whole country is arid with the exception of the forest, which is well watered by springs, and occupies an area of some 10 square miles. The timber differs greatly from the lower growth near the coast; for the trees are of great size, and where they have not been cut the forest is very dense.

Kilimanjaro, on the other hand, has a large rainfall which extends over the whole year with the exception of two or three months from mid-December to mid-March. Cultivation extends up to about 6000 ft., above which there is a dense low forest as far as 8000 or 9000 ft.* In some places there are outlying patches of forest at much lower elevations, but generally speaking the country is open and well cultivated, supporting a large population. Most of my collecting was done at about 5000 ft., and I believe my native collectors worked at much the same elevation.

(3) *Kikuyu.*

The Kikuyu country, at a height of from 5000 to 8000 ft. and even higher, is also well cultivated ground. It rises from an elevated plateau and is very hilly, especially in its northern part.

I did a little collecting at Nairobi, the head-quarters of the Colonial Government, and from there went to Kijabe,

* In the sentence "I did go as far as the forest which extends upwards for about 6000 ft.," quoted from my letter by Professor Poulton in Proc. Ent. Soc. Lond., 1906, p. lix, the word "for" should be replaced by "from."

which is on the eastern slopes of the Rift Valley and a fine forest country.

Most of my collecting, however, was done in Northern Kikuyu at a place called Weithaga (6000 ft.), about 15 miles due west of Fort Hall, and perhaps 60 miles north of Nairobi.

The country consists of a series of long ridges with very steep narrow valleys between them, running down to the plain from Mount Kinangop. Most of these valleys are swampy, but they are often well cultivated, as indeed is the whole country, the population being very large and entirely dependent on agriculture. Woods are few and the whole country is very open.

I also did a little collecting at Mogoiri (6500 ft. to 8000 ft.), which is a large district to the west, at a somewhat higher elevation, rising in its western part towards the slopes of Kinangop: also at Tuso (8000 ft.), lying still further west and even higher up on Kinangop. This last locality is, in part, low forest.

The rainfall throughout this whole area is fairly high, for such a cool country, amounting to some 50 inches, and the land is never really dried up. Green grass is plentiful even during the hot dry season, so that seasonal forms are not well pronounced. I succeeded in breeding a species of *Precis*, *P. archesia*, Cram., but all my specimens were but little removed from the full wet season phase. Both forms of *Precis sesamus*, Trim., are, on the other hand, well marked and abundant.

The material illustrating all parts of this paper exists in the Hope Department of the Oxford University Museum, where the authorities will always be glad to make it available for the study of Naturalists interested in the subject of insect bionomics.

A. Danaine-centred mimetic combinations.

Although, so far as I am aware, the mimetic *Papilio rex*, Oberth., has not as yet been taken in the Taveta and Taita districts, it is of interest to observe that the model, *Tirumala* (*Melinda*) *formosa*, Godm., certainly occurs there. I have had one specimen brought to me at Taveta, and on the journey from Voi to Taveta in 1905 I saw several

on Dabida Hill, although I was unable to capture any of them.

I. *Black-and-white Eastern Amauris-centred Combinations from the Coast District of British East Africa.*

This striking series of conspicuous butterflies contains two well-marked combinations, respectively grouped around *Amauris niavius*, L., sub-sp. *dominicanus*, Trim., and round *A. ochlea*, Boisd. It also includes a number of outlying mimetic forms which have evidently been influenced by the dominant species of black and white *Amauris*, but do not resemble the pattern of any particular model.

Although the two combinations are well marked, there is a species, *Euxanthe wakefieldi*, Ward, ♀, which possesses a pattern of the *ochlea* type and yet upon the wing more closely resembles the *dominicanus* association. It is probable that the outlying species also serve to hold both combinations together and to weld them into a single complex association of black white-marked species. For this reason, the time relationships of the whole of the members of both combinations at Rabai are recorded in a single table, which shows that many of the species fly together. This diary of captures extends over the eleven months from the beginning of March 1906 to the end of January 1907.

It must be remembered that, with the exception of the specimens taken on May 12 and on September 15, no special attempt was made to capture as complete a series as possible on a single day. Furthermore, the abundant models were avoided, while rarer species, such as the Euxanthes, were especially sought. Hence the following diary gives a wrong idea of the proportionate abundance of the constituent species.

Allowing for this, the solid fact of the occurrence of the various members of the two combinations in the same place and at the same time is proved over and over again in the following table :—

Tabular Statement of members of Black-and-White Amauris-centred Combinations captured at Rabai, March 1906–*Jan.* 1907. W = worn: C = chipped: + = greatly: − = slightly.

	DANAINÆ.		NYMPHALINÆ.							ACRÆINÆ.			PAPILIONINÆ.
DATES OF CAPTURE. 1906.	*Amauris niavius*, sub-sp. *dominicanus.*	*Amauris ochlea.*	*Pseudacræa lucretia* f. *expansa.*	*Hypolimnas* (*Euralia*) *usambara.*	*Hypolimnas* (*Euralia*) *wahlbergi.*	*Hypolimnas* (*Euralia*) *deceptor.*	*Hypolimnas* (*Euralia*) *kirbyi.*	*Euxanthe wakefieldi.*	*Euxanthe tiberius.*	*Acræa satis.*	*Acræa esebria.*	*Planema aganice.*	*Papilio dardanus* (*merope*), sub.-sp. f. *tibullus*, ♀ f. *hippocoon.*
March 3 .	...	...	...	...	...	1	...	...	...	...	...	...	...
March 31 .	...	...	...	...	...	1	...	...	...	...	...	...	...
April 7 .	...	...	...	...	...	...	...	...	1♂ C−	...	...	...	...
April 11 .	...	...	...	...	1	...	...	...	...	...	...	...	...
April 14 .	...	...	..	...	...	...	1	1♂ C−	...	...	...	...	1♀
April 28 .	...	...	...	...	1	1	3	...	3♂, 1 C−	...	...	...	...
May 12 . .	1 W	1 Pl. XXVII, fig. 1	1 W	...	1 W	...	2	2♂	...	...	...	...	1♀
May 23 . .	...	...	...	...	1	...	...	...	...	...	...	...	...
May 26 . .	...	...	...	...	..	...	1	1♂ W−	2♂ C−	...	...	...	1♀
May 28 . .	...	...	...	...	...	...	...	1♀ W−	...	...	...	...	...
June 2 . .	...	...	...	...	...	...	2	...	...	...	2♂ W− *	...	...
June 9 . .	...	...	...	...	...	...	...	1♂ C−	...	...	...	...	1♀
June 23 .	...	...	...	...	1	1	...	...	1♂	...	...	...	...
June 26 .	...	...	...	...	...	...	...	...	...	...	...	...	1♀
July 7 . .	...	...	...	...	...	...	1	...	...	...	...	...	...
July 28 .	...	...	...	...	...	1	1	...	...	...	...	...	...
Sept. 15 .	1♀ W− Pl. XXVI, fig. 1	...	...	1♀ C− Pl. XXVI, fig. 3	1 W. C.	1 W−	...	1♂	1♂ C−	...	...	...	...
Oct. 20 . .	...	...	...	...	...	...	...	1♂ C	1♂ C +	...	...	...	...
Oct. 27 . .	...	...	...	...	...	...	...	2♂	...	1♂ W	...	...	...
Nov. 3 . .	...	...	...	...	...	...	...	...	...	...	...	...	1♀ Pl. XXVI, fig. 2
Dec. 22 .	...	...	...	...	...	...	...	1♂	...	...	...	1♀ C−	...
Dec. 29 .	...	...	1 W. C., 1 Pl. XXVII, fig. 4	...	...	...	...	1♀ C− Pl. XXVII, fig. 2	...	...	...	...	...
1907.													
Jan. 5 . .	...	...	...	...	...	...	...	1♂ C−	...	...	...	...	...
Jan. 19 . .	...	...	...	...	...	...	...	...	♂♀ in cop. the ♂ W + C +, ♀ Pl. XXVII, fig. 3	...	...	...	...
Jan. 26 . .	...	...	...	...	...	...	...	1♂	1♀ W. C−	...	...	...	...

* One with ochreous markings, the other ochreous, becoming fulvous, especially in the largest marking.

a. *Amauris niavius dominicanus-centred Combination.*

This well-marked combination contains, in addition to the Danaine model, the following species, of which all except *Euxanthe wakefieldi*, Ward, ♀, are beautiful mimics. The pattern of this latter is indeed rather that of the *ochlea*-centred combination, with which it is represented on Plate XXVII, fig. 2. In the living state however, in spite of its pattern, the female of *Euxanthe wakefieldi* is more closely allied to the larger more broadly white-marked combination of *Amauris niavius dominicanus*, well shown on Plate XXVI.

NYMPHALINÆ. *Hypolimnas* (*Euralia*) *usambara*, Ward.
Hypolimnas (*Euralia*) *wahlbergi*, Wallgr.
Euxanthe wakefieldi, Ward, ♀.
PAPILIONINÆ. *Papilio dardanus*, Brown, sub-sp. *tibullus*, Kirb., ♀ f. *hippocoon*, F.

Amauris niavius, L., sub-sp. *dominicanus*, Trim.[1] (Plate XXVI, fig. 1). The central model of this association is very common in shady places, and sometimes extremely abundant; whilst its broad black and white markings make it very conspicuous.

[*Rabai*, May 1, 1906. *A. dominicanus* can almost always be distinguished even on the wing from *H. wahlbergi* and *P. dardanus*. *Wahlbergi* is almost destitute of marginal white spots and so the black and white look much more distinct; whilst *P. dardanus* has this marginal series much more developed than the model.]

Euralia (*Hypolimnas*) *usambara*, Ward (Plate XXVI, fig. 3), is the largest member of the combination, and, in spite of considerable differences in details of coloration, strongly resembles *Euxanthe wakefieldi* ♀ on the wing, when the bright, orange-brown border on the under side of the hind-wings somewhat detracts from its apparent size. As far as my experience goes it is by far the rarest species of the combination and I have only met with it in one locality at Rabai.

[*Rabai*, September 12, 1908. I have taken two more specimens of *Euralia usambara* a week ago. I must confess that the first took me in completely. It was hovering over the end of a branch quite in the manner of the *Amauris* model, for which I mistook it, and was just considering whether I should catch it for my spiders, when it

settled and I saw what it was. Another appeared on the scene soon afterwards.]

Euralia (*Hypolimnas*) *wahlbergi*, Wallgr. (Plate XXVI, fig. 4), is common, and is, like the *Amauris*, a denizen of woods and forests, but its habits are somewhat different. It prefers the more open parts of the woods and generally sits on the upper side of leaves and thence pursues butterflies of its own and other species; but it not unfrequently may be seen resting with its wings hanging down in a position entirely similar to that of *dominicanus*, and such is probably its usual position of rest at night. It is quite possible that this attitude is of great importance in the struggle for existence, and I would offer the suggestion that the period of nocturnal rest may be far more dangerous to many species than the more active period of the day, when, to judge from the rarity of observed attacks by birds, most butterflies are quite able to take care of themselves. The period of rest, however, begins for butterflies at a time of the day when birds are most active in the pursuit of food, whereas the butterflies are quiescent and would, if discovered, fall an easy prey to their enemies. This principle has also been observed to be in operation in Siam by Mr. N. Annandale,* and in South Africa by Dr. G. B. Longstaff.†

Euxanthe wakefieldi, Ward, ♀ (Plate XXVII, fig. 2). The males of this species do not really come into the association at all, but the female is largely modified in the direction of the *Amauris* by the increased size of all the pale spots and areas, and also by their colour, which is much lighter and whiter in tint, so that on the wing the butterfly appears to be simply black and white. This resemblance is greatly increased by the shape of the wings as compared with those of its own male, which has the fore-wings exceedingly short and broad,—so much so as to give it a very distinctive appearance, especially in flight. On the other hand, the wings in the female are much produced so as to approximate in shape to those of the primary model. During flight this female bears an even closer resemblance to the Papilionine co-mimic, shown on Plate XXVI, fig. 2, than to the Danaine model (Fig. 1), especially in the prominently spotted dark border of the hind-wing. In habits *E. wakefieldi* resembles more closely

* Proc. Roy. Phys. Soc. Edinb., 1900, No. xxix, pp. 439–44.

† Trans. Ent. Soc. Lond., 1906, p. 118.

the species of *Euralia*, being generally seen sitting on the outer leaves of trees, and the males being very fond of pursuing each other with great activity. It is, however, frequently to be found at rest on tree-trunks, and I have observed the female settled with its wings pendent, and in this position bearing a very strong resemblance to the Danaine model. I have little doubt that this species is specially protected and a Müllerian mimic. The facts stated about the allied *E. tiberius* (p. 501) are equally true of *wakefieldi*.

[*Taveta*, July 5, 1905. They are very fond of chasing each other round and round and have a very graceful floating flight, which no doubt accounts for their becoming mimics of *A. dominicanus*, of which the flight is somewhat similar. The male generally settles on tree trunks, but I have seen the female more than once settle on a branch or twig with its wings hanging down exactly after the manner of *A. dominicanus*, to which it bears a strong resemblance on the wing.]

Papilio dardanus, Brown, sub-sp. *tibullus*, Kirby, female form *hippocoon*, F. (Plate XXVI, fig. 2). This is by far the commonest form of the female and is of very frequent occurrence. It is readily distinguished during flight by the prominent sub-marginal spots in the dark border of the hind-wing. I have met with this form in some abundance as far away as Nairobi in the Kikuyu country, and it remains the dominant variety of the female from this locality westward to the Atlantic coast.

1. *The Relative Abundance of the members of the Amauris niavius dominicanus-centred Combination.*

In my experience *Euralia usambara* is the only really rare member of the association, and the only one with a restricted range. All the other constituent species have a considerable range in the Coast district. The relative abundance of the different species varies considerably in different localities. At Taveta, for instance, the primary model, *A. niavius dominicanus*, outnumbered many times all the others; while at Rabai its dominance was by no means so well marked.

b. *Amauris ochlea-centred Combination.*

In addition to the Danaine model this combination contains the following species, of which all except *Euxanthe*

tiberius ♀ are fairly good mimics. This combination is however more distinguished than that last described by the strength and beauty of the secondary mimetic resemblances. The model and chief Nymphaline mimics are well seen, represented $\frac{5}{6}$ of the natural size, on Plate XXVII. The plate includes the female of *Euxanthe wakefieldi* (Fig. 2) with a pattern resembling that of this combination, but in life an outlying member of the association with *A. dominicanus* for its centre.

NYMPHALINÆ. *Pseudacræa lucretia*, Cram., sub-sp. *expansa*, Butl. (Plate XXVII, fig. 4).
Euralia deceptor, Trim. (Fig. 6).
Euralia kirbyi, Butl. (Fig. 5).
Euxanthe tiberius, Gr.-Sm., ♀ (Fig. 3).
Aterica galene, Brown (white f. of ♀).

Amauris ochlea, Boisd. (Plate XXVII, fig. 1). The habits of the central model of this association are quite like those of *A. niavius dominicanus*, except that it is a little more partial to the open country, and is fonder of flowers.

Pseudacra lucretia, Cram., sub-sp. *expansa*, Butl. (Plate XXVII, fig. 4). This species often settles on leaves with wings expanded, and in every way it has much more the appearance of a large *Neptis* than any of the other members of the combination. Although the pattern of this species so closely resembles that of the two Euralias the *Pseudacræa* appears whiter on the wing and has a more floating flight. It is possible that the characteristic curve of the large spots of the fore-wing, to which Professor Poulton has drawn attention, has been influenced by the curved band in the fore-wing so well marked in this genus, of which *N. agatha* is a good example. I have only seen the species near Rabai.

Euralia deceptor, Trim. (Plate XXVII, fig. 6), and *E. kirbyi*, Butl. (Fig. 5). The two Euralias resemble one another strongly, especially on the wing, and are active insects very fond of pursuing butterflies of their own and other species. I have little doubt, however, that in the position of permanent rest they would follow the Danaine model, and in fact I have observed *E. deceptor* in this attitude.

[*Mombasa*, April 5, 1905. I have only seen *Pseudacræa expansa* near Rabai, and *Hypolimnas* (*Euralia*) *deceptor* and

wahlbergi I have only taken in the same district, i. e. on the Coast hills. *H. deceptor* is not uncommon, but it is very difficult to get in good condition.]

[*Rabai*, May 1, 1906. The first specimen of *H. deceptor* I ever captured was settled with its wings hanging down just like *ochlea*, but I have never observed this since and I have seen dozens of the species. It is very fond of settling on the outer leaves of small trees and chasing its companions from time to time, and on the wing is not at all unlike *H. misippus*.]

[*Euralia kirbyi* is included in the observations on *E. deceptor* recorded in the above extracts from two letters. The two species, which are extraordinarily alike, were not at first discriminated. E. B. P.]

[*Rabai*, May 9, 1908. I saw a good many *Euralia deceptor* and *kirbyi* last Saturday, which was a fine day after rains earlier in the week, but they were mostly in bad condition and the better specimens were flying high. I also caught two or three *Euxanthe wakefieldi*, but they were none of them perfect, and I did not keep any.]

Euxanthe tiberius, Gr.-Sm., ♀ (Plate XXVII, fig. 3). The female of this species should also be included in the combination, although the male is very distinct. It is true, however, that the conspicuous fulvous patch on the inner part of the fore-wing at once distinguishes the female from all the other members, and is a prominent feature even on the wing. The development of the white patch on the hind-wings is the more striking because of its total absence in the male. As a further mimetic modification of the female, all the pale spots in the fore-wing are larger and whiter than in the male. I am strongly of the opinion that *E. tiberius* itself must be regarded as a protected species and a Müllerian mimic. Unless thoroughly disturbed, it is a very sluggish insect and is most conspicuous on the wing, especially in the deep shade which it loves. It is true that the texture of the wings is much softer and more readily torn than that of species like *A. niavius dominicanus* and *ochlea*, but the body is extremely tough, and I have found it exceedingly difficult to kill by pressure between the finger and thumb,—even more so than *Danaida* (*Limnas*) *chrysippus*, L.

[*Rabai*, May 1, 1906. I have captured a fine *Euxanthe* [*E. tiberius*] which is quite new to me. This was a great surprise, as I have worked this district pretty hard, and

it is not an insect one would be likely to pass over. I have taken in all three specimens which I send you, two of them being not quite perfect, whilst the third is as good a specimen as one could wish for. All three were taken in the same locality, on the site of the old capital of the Rabai tribe (called *New* Rabai), which has long been deserted, though it is still resorted to for sacrifices and other superstitious practices. All three specimens were taken in deep shade, and its flight seems heavy and feeble, but as, in each case, I captured the specimen at first sight I cannot say whether it would prove more active if it were alarmed. I should say that this locality occupies the top of a high hill just opposite the present town of Rabai, with a deep ravine between, whilst on the other side there is a precipitous descent of about 700 ft. almost to sea-level. It is in part covered with forest and seems a splendid locality.]

[*Rabai*, July 29, 1906. All the specimens of *E. tiberius* but one have been taken in almost exactly the same spot. During the daytime it rests on trees with its wings upright, and if alarmed goes off at a good rate, and dodging amongst the trees is soon lost to sight; but it seems to be an insect of sluggish habits, and I have never seen them sporting together in the manner of *E. wakefieldi*. I took one specimen which had evidently retired for the night resting on the under side of a leaf with its wings hanging down.]

[*Rabai*, May 9, 1908. The dry hot weather lasted on till the middle of April when all insects were rather scarce. It was noticeable that *Euxanthe tiberius* was much more wary and difficult to take than usual during this time. When on the alert it has a provoking habit of going off in the forest and settling on a tree-trunk some 20 or 30 yards away, and then when you stalk it with great care it waits till you are nearly within reach and then goes off and repeats the performance.]

Ateriea galene, Brown, ♀, may also be associated with this among other combinations. The species is common in woodland and forest areas on the Coast hills, where the intense light and shade make it anything but conspicuous when settled on the ground. The colour of the pale patch on the hind-wing of the female varies considerably, being sometimes white. The individuals with an ochreous patch fall naturally into the *Amauris echeria* and *albimaculata*

centred combination (see pp. 511, 512). The under side is of course procryptic, so that it can hardly be regarded as a distasteful insect. Professor Poulton has pointed out (see p. 505) that there are certain features in the markings of the fore-wing which are apparently secondarily associated with the *Pseudacræa* and *Euraliæ* of this combination.

1. *The Relative Abundance of the members of the Amauris ochlea-centred Combination.*

The relative abundance of the members of this combination varies a good deal in different localities and stations, as was seen to be the case with regard to the *A. niavius dominicanus* combination. At Rabai the two Euralias predominate in the wooded country, and are even more in evidence than the primary model, whilst on a tour further north in the Giryama country I found *P. lucretia expansa* the most numerous member, especially at Mangea.*

[*Rabai*, August 29, 1908. I am sending you two *Euralia kirbyi* and one *Pseudacræa lucretia*, taken in Dida Forest, which is a large area of low dense forest, a little south of Kaembeni on the way to Jilore. The *Euralia* was quite common, and I netted other specimens which were not good enough to keep, but for the whole distance, some 8 miles, I never saw *Amauris ochlea* at all. In fact, I have found that both the *Amauris* are more local than the Euralias, though very abundant in places. Moreover, I have seldom seen them flying with either the *Euralia* or the *Pseudacræa*, which is of considerable interest in view of the fact that the mimics resemble each other more closely in some respects than either does the primary Danaine model.]

2. *Secondary Resemblance between the Nymphaline members of the Amauris ochlea-centred Combination.* E. B. P.

I have been much struck with the apparently strong secondary likeness between *Pseudacræa lucretia expansa*, *Euralia deceptor*, and *E. kirbyi* so often taken by the

* [A considerable number of the members of this and the *dominicanus*-centred combination from Coast localities N. of Rabai, and also from Taveta, and a few from Taita and Kilimanjaro, have been presented by the author to the Hope Department. It has not been thought necessary to tabulate them in view of the more complete records from Rabai printed on p. 496; but it is well to point out that these specimens from additional localities also afford strong evidence that the species occur at the same places and are often seen upon the wing together. E. B. P.]

author in the same locality and on the same or nearly the same date. The two Euralias are so much alike in pattern that they might easily be mistaken even in the cabinet, while their resemblance to the pattern of the *Pseudacræa* is also very marked. There can be little doubt that this is not an incidental result of resemblance to the same Danaine model, but that it is a genuine case of secondary mimicry. The most characteristic element in the pattern of the *Pseudacræa* is a curved series of white spots crossing the fore-wing and forming together a marking which suggests a thick "comma." The concave side of the curve is directed towards the base of the wing, and the point of the "comma" rests in the cell. This well-marked feature occupies nearly the position and is mimetic of the chief white marking in the fore-wing of *Amauris ochlea*. It is, however, of a more peculiar and characteristic shape in the mimetic *Pseudacræa*, and the two Euralias which resemble it, than in the model. Hence there can be little doubt about the existence of a true secondary approach between these representatives of the two Nymphaline genera. The question furthermore arises as to whether *Pseudacræa* or *Euralia* has acted as the model. Although all three species appear to be common in the neighbourhood of Rabai, it is probable that *Pseudacræa lucretia expansa* is the model followed by its Nymphaline co-mimics. The secondary resemblances described above are well shown in Figs. 4–6 of Plate XXVII. The peculiar marking, with some modification, occurs in other sub-species of *lucretia*, between them covering a very wide range—in *tarquinia*, Trim., of the south-east; in the abundant form (with points of resemblance to both *tarquinia* and *expansa*) from the N.E. of the Victoria Nyanza; and in *lucretia lucretia* of the West Coast. The two Euralias have a far more limited distribution, being apparently confined to areas where the marking reaches its most characteristic development in the *Pseudacræa*. There is no doubt, as the author pointed out to me, when we were studying the Hope Collection together, that the central markings in the fore-wing of *Euralia dubius*, Pal. (neighbourhood of the Victoria Nyanza to the W. Coast), tend to exhibit a peculiar curve which may indicate affinity with *E. deceptor* rather than the usually accepted affinity with *E. mima*,* Trim., but the relation-

* Upon the under surface, *Euralia dubius* appears to resemble *E. mima* much more closely than it does *E. deceptor* and *E. kirbyi*.

ship between the markings does not support the conclusion that the feature is primitive in the Euralias. In fact *E. dubius* has itself been so strongly modified by mimicry of western species of *Amauris*, that the marking under consideration usually exhibits only a slight although recognisable resemblance to that of *E. deceptor* and *E. kirbyi*.

The peculiar curve in the chief band of white spots crossing the wing of the female *Euxanthe tiberius* (shown on Plate XXVII, fig. 3) has also probably been produced by secondary mimicry either of the *Pseudacræa* or the *Euralix* which occur in the same locality. The case of the widespread Nymphaline *Aterica galene* with its variable female is more puzzling. But here also we find in both sexes and in all forms of the female the same peculiar curve in the chief band of pale spots crossing the fore-wing. If this marking has been affected by secondary mimicry the species has at any rate carried it far away from the area where the most characteristic development is reached by the model. This however would not be the only example of *A. galene* ranging beyond its model. Thus it is shown on p. 512 that the *Amauris echeria*-and-*albimaculata*-like form of the female—and in this case the mimetic resemblance cannot be doubted—occurs in localities near Mombasa, where its Danaine model is unknown. The two dark spots (generally fused in male, often in female, occasionally very minute or perhaps altogether wanting) in the cell of the hind-wing under side may possibly indicate resemblance to the well-known group of spots occupying this position in the *Pseudacræa*. E. B. P.

c. *Outlying members of the Black-and-White Eastern Amauris-centred Combinations.*

Nymphalinæ. Mr. G. A. K. Marshall has shown that the African species of the genus *Neptis* have certain features which indicate that they should be regarded as outlying members of this large and complex combination. He has also brought forward evidence which points to the conclusion that they are themselves distasteful. There are three species of this genus which I have taken commonly: —*N. agatha*, Stoll.; *N. marpessa*, Hoppf., and *N. melicerta*, Drury. All these have a wide distribution and are commonly met with. The most abundant species is *N. agatha*, and there is no doubt that, in the distribution of its black

and white markings, it approaches most nearly to the central members of the group. Moreover it is extremely variable in size, some of the largest females nearly equaling *Amauris ochlea*, whilst the smallest males are no larger than average specimens of *marpessa* and *melicerta*. The species of *Neptis* are very conspicuous on the wing and have a leisurely floating flight, but they are very active and are not taken nearly so easily as one would be led to expect.

Besides these three species of *Neptis* we have two species of another Nymphaline genus which strongly resemble them, i. e. *Neptidopsis ophione*, Cram., and *N. fulgurata*, Boisd., sub-sp. *platyptera*, Rothsch. and Jord. Now although these belong to a genus so distinct in structure, being in fact *Eurytelids*, yet during life they bear a very strong resemblance to the genus *Neptis* both in appearance and in habits. *N. ophione* is certainly an abundant species, and I should regard *N. fulgurata platyptera* as quite common, though, as far as my experience goes, its range is far more restricted.

Associated with these species of *Neptis* I should place a most interesting Lycænid, *Alæna picata*, E. M. Sharpe, which departs widely from the style of colouring usual in the family, and assumes the strongly contrasted black and white markings characteristic of this great combination. This species is not common, but I think it possible that it may frequently be overlooked on account of its strong resemblance to a small *Neptis*. It is true that the details of pattern differ somewhat from those of any species of the genus *Neptis* with which I am acquainted, but I have found the Lycænid very difficult to distinguish on the wing. Its flight is even more feeble and may exhibit something of the "floating" appearance of *Neptis*, while it frequents exactly the same localities: even in size it approaches the smaller specimens of e. g. *N. melicerta*. Moreover, the genus *Alæna* has been shown by Mr. G. A. K. Marshall to be in all probability distasteful, and this renders it likely that the species is a Müllerian member of the combination.

[*Rabai*, May 1, 1906.

This species [*A. picata*] when taking its longer flights looks almost like a moth, moving its wings with considerable rapidity.]

[Address and date lost.

This Lycænid [*A. picata*] bears a curious resemblance to a small *Neptis*, but its flight is much more feeble and the "floating" character much less pronounced, so that it is generally recognisable although with difficulty. It also rests, as do most of its allies, with its wings hanging down, which at once betrays it.]

Before leaving *Neptis* it would be as well to refer to another species of the same genus, *N. incongrua*, Butl., which has the same contrasted black and white markings distributed in a manner different from that of Ethiopian species generally. Its peculiar pattern produces a close resemblance to *Eurytela hiarbas*, Drury, which is found in the same localities. The first specimen of *N. incongrua* which I captured quite deceived me, and it was not until I had the butterfly in the net that I discovered that it was not *E. hiarbas*. Now that I am better acquainted with both species it is not likely that I should make any such mistake even when the insects were on the wing, but there is no doubt that the resemblance is more than accidental. Mr. Marshall has recognised the resemblance of an allied species of *Neptis* in S.E. Rhodesia to *Eurytela hiarbas*.*

Acræinæ. There are also the females of two large abundant *Acræinæ* which, with their mimics, should, no doubt, be looked upon as outlying members of this combination. The general effect of their pattern certainly suggests that of the black and white species of *Amauris*, although, as in the genus *Neptis*, the details of the marking are obviously different. The central species of this

* Before leaving the *Nymphalinæ* I should wish to draw attention to a possible case of mimicry in the genus *Charaxes*. Mr. G. A. K. Marshall has suggested possible cases of mimicry of one *Charaxes* by another, and I think we have a parallel example at Taveta.

When looking through the series of *C. etheocles*, Cram., at Oxford, I found that the two female specimens I took at Taveta differed from those Mr. Wiggins obtained in the region of the Victoria Nyanza in two respects, i. e. the fulvous colouring on the fore-wings was more extensive, and the white bar in the hind-wings was much narrower. In both these differences the Taveta specimens approach *C. saturnus*, Butl., and it is noteworthy that whereas *C. saturnus* was common at Taveta, yet Mr. Wiggins did not send home a single specimen from the Victoria Nyanza in his very fine series of *Charaxes* from this region.

group is the female of *Planema aganice*, Hew., form *montana*, Butler, which is found commonly in many localities in East Africa. Associated with it are the white-marked forms of the female of the common *Acræa esebria*, Hew., and of *A. carmentis*, Doubl., which I have once received from Kilimanjaro. I have also once taken the female of a *Pseudacræa*,* probably the eastern representative of the western *P. hirce*, Drury. This white-marked female is a beautiful mimic of the female *Planema*. These three species are so similar in pattern and flight that I do not think it is possible to distinguish them on the wing. They all have the characteristic leisurely flight of the *Acræinæ*, and, from their large size and strongly contrasted black and white colouring, are distinctly suggestive of the *Amauris niavius dominicanus*-centred combination. Other mimetic resemblances of and between the males of these two common Acræas will be described on p. 523. They are considered with the other *Acræa*-centred combinations, because the pattern of the males does not, like that of the females, enter into a distant relationship with any of the *Amauris*-centred associations.

Another outlying member belonging to the same subfamily is the female of *Acræa satis*, Ward, which I have found not unfrequently in the Coast district, and even on Mombasa island. Here again, although the details of marking are very different, in size and colour the species certainly approaches this great black and white combination.

Pierinæ. Professor Poulton has suggested that *Glutophrissa saba*, Fab., ♀, should be regarded as an outlying member of the combination, but as far as my experience goes this species is always an unmistakable Pierine, and does not resemble the other members in its habits or appearance.†

Papilioninæ. I am somewhat more doubtful as to the position of *Papilio philonöe*, Ward, which certainly has a floating flight. It bears more resemblance to *Pseudacræa lucretia expansa* than to any other member of the combination, but the white areas are much more extensive and it can always be easily recognised.

* *Pseudacræa rogersi*, sp. nov. See Appendix, p. 549.

† Mr. Roland Trimen suggested in 1881 (Proc. Ent. Soc. Lond., p. vii) that the ♀ *saba* might be a mimic of the widely-spread and evidently protected African Hypsid moth, *Nyctemera apicalis*, Walk.

II. *Amauris echeria-and-albimaculata-centred Combination from the Kikuyu Country.*

My experience of this interesting combination has been chiefly derived from recent visits to the Kikuyu country, although I have also encountered it on and near Kilimanjaro. The following captures at various localities in the Kikuyu country will give some idea of the relative abundance of the models and their various mimics.

(a) *Weithaga.*

The numbers of specimens of this group taken at Weithaga have been arranged in the following tabular form by Professor Poulton.

Weithaga. DATES.	DANAINÆ. Primary model (*echeria* not taken). *Amauris albimaculata.*	NYMPHALINÆ. Mimic, with secondary resemblance to *Acræa johnstoni*. *Neptis woodwardi.*	ACRÆINÆ. Mimic. Forms of *Acræa johnstoni.*	PAPILIONINÆ. Mimic. ♀ of *Papilio echerioides.*
1906.				
Aug. 11 . .	...	1 ♀ rather worn. Pl. XXIX, fig. 2.	...	...
Aug. 13 . .	...	1 ♂ a little worn.	1 ♂ *fallax*—worn.	...
Aug. 16 . .	2 ♂	...	1 ♂ *fallax*—worn.	...
Aug. 18 . .	...	1 ♂ worn.	1 ♂ *fallax.*	...
Aug. 22 . .	...	...	...	1 ♂
1907.				
March 9 . .	...	...	...	1 ♂
March 16 .	1 ♂	...	1 ♂ *fallax*—worn.	...
March 30 .	1 ♂	...	2 ♂ 1 ♀ *fallax.*	1 ♂ chipped. 1 ♀ Pl. XXVIII, fig. 4.
April 4 . .	1 ♂	...	...	...
April 5 . .	...	...	1 ♂ *proteina*—worn.	...
April 13 . .	3 ♂, 1 ♀	...	...	...
April 18 . .	...	1 ♂ chipped.	...	...
April 20 . .	1 ♂	...	...	...
May 10 . .	...	1 ♂ a little worn. Pl. XXIX, fig. 1.	...	...
May 11 . .	1 ♂, 1 ♀	...	...	...

Unnoted specimens in good condition.

All the mimics have white spots in fore-wing and yellowish patch in hind except the males of the *fallax* form of *A. johnstoni*, Godm., which have yellowish spots in fore-wing. [The *fallax* are very interesting in that they resemble the two specimens captured by Mr. and Mrs. S. L. Hinde, one at Fort Hall and the other above the Goura River, and described as trending in the direction of *johnstoni* in Trans. Ent. Soc. Lond., 1906, p. 309. E. B. P.]

These captures compare in an interesting manner with those made by C. A. Wiggins, near the N.E. shores of the Victoria Nyanza, and described by Mr. S. A. Neave, M.A., B.Sc., F.E.S., in Trans. Ent. Soc. Lond., 1906, pp. 213, 214.

(b) *Nairobi.*

1906, Aug. 30. *P. echerioides*, Trim., 1 ♂.

1907, Feb. 2. *Acræa johnstoni*, Godm., f. *semifulvescens*, Oberth., 1 ♂ slightly worn.

Feb. 4. *P. echerioides*, 3 ♂, 2 slightly worn; the third represented in Plate XXVIII, fig. 5.

P. echerioides, 1 ♀, worn, and right hind-wing notched.

P. jacksoni, E. M. Sharpe, 1 ♂. Represented in Plate XXVIII, fig. 3.

P. dardanus, probably sub-sp. *tibullus*, 1 ♂. Represented in Plate XXVIII, fig. 7.

P. dardanus, probably sub-sp. *tibullus*, 1 ♀ of the *ecnea*, Stoll., form, somewhat transitional towards the *hippocoon* ♀ f., worn and much chipped, apparently by birds. Represented in Plate XXVIII, fig. 6.

Acræa johnstoni, form *flavescens*, Oberth., 1 ♂, worn.

On this last-named day many other males of both *P. echerioides* and *P. dardanus* were seen and several females of the *hippocoon* form of the latter. It is interesting to note that although the model was not taken, no less than three species of *Papilio* possessing *echeria-albimaculata*-like females were captured on Feb. 4.

(c) *Kijabe.*

1906, Aug. 3. *Amauris albimaculata*, Butl., 1 ♂. Represented in Plate XXVIII, fig. 1.

Papilio jacksoni, 6 ♂, 3 ♀.

1 ♂ with right hind-wing with anal half shorn off; rather worn.

1 ♂ and 1 ♀, each with chip in left hind-wing, the ♂ a little worn, the ♀ fresh.

Of the rest, 2 ♂ and 2 ♀, a little worn; the most perfect ♀ is represented in Plate XXVIII, fig. 2.

Aug. 6. *P. jacksoni*, 2 ♂ and 2 ♀. Both females worn, one slightly.

1907, Feb. 6. *P. jacksoni*, 1 ♂ and 2 ♀. Both females worn, one slightly, and both chipped near anal angle of hind-wing.

(d) *Mogoiri* and *Tuso*.

1907, April 29. *Amauris albimaculata*, 2 ♀, rather worn.

March 1. *A. albimaculata*, 1 ♀, much worn.

Neptis woodwardi, E. M. Sharpe, 1 ♂, worn, hind-wing patch white.

March 2. *N. woodwardi*, 2 ♂, one a little worn.

1. *The Primary Danaine Models.*

In Kikuyu *Amauris albimaculata*, Butl., is the dominant species and all my specimens belong to it, whereas on Kilimanjaro *Amauris echeria*, Stoll., is also commonly found, as is usually the case where *A. albimaculata* occurs. It is quite probable that *A. echeria* exists in Kikuyu, but it must have been comparatively rare in the under-mentioned localities at the times when I visited them.

2. *Nymphaline Mimics.*

I have never met with *Euralia mima*, Trim.;* and the British East African forms of *Pseudacræa lucretia* seem to fall more properly into the group of which *A. ochlea* is the centre. Certain varieties of the female in the closely allied sub-species *tarquinia* from Natal are, on the other hand, excellent mimics of *Amauris echeria* and *albimaculata*.

A form of the female *Aterica galene* appears to be a well-marked member of this group, while the male is a more outlying member. Although probably always mimetic this species is very independent of the local

* When glancing over the splendid collection of Congo butterflies in the Brussels Museum, under the kind direction of Monsieur Severin, I noticed several *echeria*-like specimens of *Euralia dinarcha*, Hew.—the var. *bartteloti*—Grose-Smith, from Beni Bendi, in the central part of the State. I was astonished at this because it was fairly certain that the well-known models did not exist in that locality. Turning to the *Danainæ*, it was at once evident that a form of *Amauris egialea*, Cram., with an ochreous hind-wing patch, occurred at the same locality and supplied the model. E. B. P.

presence of its models, and the specimens of this particular form of the female with a brown patch on the hind-wing were taken in the coast localities from which the Danaine model is in my experience absent, although it is common near Voi, 100 miles inland. These captures of *galene* in the coast localities were as follows:—Kaya Kauma (Aug. 21, 1903), Rabai (May 10, 1906), Jilore (July 16, 1906), Ndzovuni (July 21 and Oct. 5, 1906).

[Address and date lost.

Aterica galene bears some superficial resemblance in colour to *Amauris albimaculata*, but its habits are quite different. Like all this group it is fond of sitting on the ground in paths of woods where there is much light and shade. If disturbed it merely flies a little way and settles again.

Acræa johnstoni and *Neptis woodwardi* bear somewhat the same relation to this group as *Planema aganice* and its *Pseudacræa* mimic bear to the black white and *A. niavius dominicanus* group, viz. the relation of a pair of secondarily associated butterflies which are also members of a large combination surrounding a primary Danaine model. Both *Acræa* and *Neptis* resemble each other in habits, and on the wing it is difficult to distinguish them. Their appearance is, generally speaking, not dissimilar from that of the primary model in spite of its much greater size.]

[*Rabai*, Sept. 30, 1906.

Of those new to me [in Kikuyu] the most interesting was a species of *Neptis* [*N. woodwardi*] which seems to have been modified so as to resemble *Acræa johnstoni*, though the resemblance is not very close.]

Professor Poulton has added to this account of the Nymphaline mimics of the *Amauris echeria*-and-*albimaculata*-centred combination a comparison of the specimens of *Neptis woodwardi* captured far to the W. of the Rift Valley with those taken by me just E. of it.

(a) *Specimens of Neptis woodwardi from the E. of the Rift Valley compared with those from the W.* E. B. P.

It is very interesting to compare the 8 specimens of *Neptis woodwardi*, E. M. Sharpe, obtained by Mr. St. Aubyn Rogers on the eastern heights overlooking the Rift Valley, with the equal number captured by Mr. C. A. Wiggins

near the N.E. shores of the Victoria Nyanza, far to the W. of the Valley. Mr. Wiggins obtained 7 specimens from the Tiriki Hills, about 20 miles north of Kisumu.* These hills are covered with dense forest, and the collection was made at a height of about 5100 ft. An eighth specimen was captured by Mr. Wiggins at Kakamega's (5500 ft.) near Mumias on the Uganda Railway, about 15 miles N.E. of Kisumu—a locality which did not come within the scope of Mr. Neave's paper in the Novitates Zoologicæ. The 8 specimens were captured by Mr. Wiggins on the following dates:—

Kakamega's, Dec., 1902 ...	one male.
Tiriki Hills, Feb. 26, 1903 ...	two males: one represented in Pl. XXIX, fig. 3.
Tiriki Hills, Feb. 27, 1903 ...	one female: represented in Pl. XXIX, fig. 4.
Tiriki Hills, Mar. 17, 1903 ...	two males, one female.
Tiriki Hills, Mar. 19, 1903 ...	one male.

Corresponding with the fact that Mr. Rogers' specimens came from the E. of the Rift Valley in a country where the influence of the dominant *Amauris albimaculata* (and perhaps *echeria*, see p. 511) is at its highest and the mimetic combination surrounding it of the greatest size, the individuals of *Neptis woodwardi* are distinctly better mimics than those obtained by Mr. Wiggins in an area where the two species of *Amauris* are less dominant and attract a smaller association of mimetic species (compare Figs. 1 and 2 with 3 and 4 on Plate XXIX). The four white spots in the fore-wing are larger, and generally much larger, in the eastern forms. A minute fifth white spot close to the costa of the fore-wing is present in all the E. specimens, absent from all the W. males except the one captured on March 19. All possess this marking upon the under surface, although in one of the Tiriki males it is exceedingly minute. The feature upon which the mimetic resemblance chiefly depends is the ochreous bar crossing the hind-wing. This is so narrow in the W. males (Plate XXIX, fig. 3) that they can hardly be said to belong to the *echeria*-centred combination at all. The two W. females

* S. A. Neave in Nov. Zool. Vol. XI, 1904, pp. 323 and 350, 351. See also Trans. Ent. Soc. Lond., 1906, p. 214, where the same author points out that *Neptis woodwardi* is an outlying member of the *A. echeria*-and-*albimaculata*-centred combination.

(Plate XXIX, fig. 4), however, in which the bar is much wider and the white spots in the fore-wing much larger, are distinct members of the combination, with a strong secondary approach towards the *proteina*, Oberth., form of *Acræa johnstoni*. The E. males (Plate XXIX, fig. 1) resemble these two W. females in both size of spots and breadth of the ochreous bar, so that they too are well-marked members of the association. The single E. female (from Weithaga) is developed still further in the same direction (Plate XXIX, fig. 2), being as far in advance of the E. females as these are beyond their own males.

It is probable that *Neptis woodwardi* has been developed from a form resembling *N. incongrua*. As regards the reduction of the spots in the fore-wing and the loss of the fifth spot the W. males are more specialised than the E. As regards the development of an ochreous patch out of a narrow band the E. males and especially the female are the more specialised. In *N. incongrua* the numerous white spots form an irregular bar across the fore-wing. By the loss of certain spots the bar-like appearance disappears in *N. woodwardi*, while just those elements are retained which bring about the mimetic resemblance to *Acræa johnstoni*. In the same manner the narrow white bar crossing the hind-wing of *incongrua* is withdrawn towards the base, broadened, and transformed into ochreous in *woodwardi*,—all of which changes are in the directions of the Acræine secondary and Danaine primary models. The hind-wing bar of *woodwardi* from both E. and W. of the Rift Valley occasionally retains more or less of the white ground of *incongrua*. In such examples the costal end of the bar is generally tinged with ochreous. E. B. P.

3. *Acræine Mimics.*

The resemblance of the *proteina*, *flavescens*, and *fallax* (= *kilimandjara*, Oberth.) forms of *A. johnstoni* to the *echeria-albimaculata* models was described and figured by Professor Poulton in 1906,* together with the likeness of the forms *fulvescens*, Oberth., and *semifulvescens*, to very different Danaine and Acræine models. The mimicry of *Amauris echeria* by the commonest forms of *A. johnstoni*, viz. *proteina* and *flavescens*, had been suggested by the same naturalist as early as 1897.† His 1906 memoir

* Trans. Ent. Soc. Lond., 1906, pp. 299-311, Plates XXI, XXII.

† Report British Association, Toronto, 1897, pp. 688-691.

above referred to, dealt with the material obtained by me in Taveta and from the slopes of Kilimanjaro, but no complete list of specimens is given in it. Later captures have so far increased the series of this protean species as to make it worth while to publish the whole list from these localities and from Dabida Hill in the Taita district. It will be thus possible to gain some idea of the relative abundance of the various widely separated forms.

(*a*) *Tabular statement of the forms of Acræa johnstoni captured at Taita, Taveta, and Kilimanjaro, May* 1904–*Jan.* 1906.

LOCALITY AND DATE.	Forms of *Acræa johnstoni*, Godm. (including *fallax*, the eastern representative of *A. lycoa*, Godt.).					
	proteina.	*fallax* ♀.	*fallax* ♂.	*flaves-cens.*	*semi-fulvescens.*	*fulvescens.*
TAITA, DABIDA. 1904.						
May 25 . .	...	...	...	1 ♂ W	...	...
May 26 . .	1 ♀ W	...	...	...	...	...
May 30 . .	...	...	...	1 ♂	...	1 ♂
May 31 . .	1 ♂ W –	...	...	...	...	...
June 8 . . .	1 ♂	...	...	...	...	...
TAVETA. 1905.						
April 21 . .	1 ♀	...	...	1 ♂	...	...
May 15 . .	...	...	...	...	1 ♀ F_1	...
KILIMANJARO.						
May . . .	1 ♂ W	...	...	...	...	1 ♀ W +
KILIMANJARO, MAMBA STATE, about 5000 ft.						
Sept. 15 . .	...	...	1 ♂ W –	...	...	...
Sept. 21 . .	...	...	1 ♂	...	...	...
Sept. 26 . .	1 ♂ W	...	1 ♂ W	...	1 ♂ F_2	...
KILIMANJARO.						
Dec. 15–31 .	...	2 ♀ 1 W 1 F_3	1 ♂ F_4	3 ♂ 2 W 1 F_5	1 ♂ W	1 ♂ F_6
1906.						
Jan. 5–16 . .	2 ♂ W *	...	2 ♂ W –	...	2 ♂ W	3 ♂ 1 W 1 W –
Totals . . .	6 ♂ ; 2 ♀	2 ♀	6 ♂	6 ♂	4 ♂ ; 1 ♀	5 ♂ ; 1 ♀

* One captured Jan. 26–31, 1906.

The following specimens are figured by Professor Poulton in Trans. Ent. Soc. Lond., 1906, p. 281.

F 1	figured in Trans.	Ent. Soc.	Lond., 1906:	Plate XXII,	Fig. 2^a.
F 2	„	„	„	Plate XXI,	Fig. 3^a.
F 3	„	„	„	„	Fig. 2^a.
F 4	„	„	„	„	Fig. 1^a.
F 5	„	„	„	„	Fig. 1^b.
F 6	„	„	„	„	Fig. 4^a.

The tabulated examples of *flavescens* possessed very pale ochreous spots in the fore-wing, so that it was difficult to distinguish worn specimens from *proteina* with its white spots. Omitting the consideration of *fallax*, which may be a distinct species, it is seen by this list that *semifulvescens* is by no means rare as compared with the other two forms.

[So far as this comparatively short list enables us to judge, *fulvescens* is nearly half as numerous and *semifulvescens* about a third as numerous as the combined *protcina* and *flavescens* forms. This means that they are far from rare, and helps us to understand the probable secondary mimicry of *fulvescens* by the under side of the female *Acræa uvui*, Grose-Smith. A single specimen of the female of this small *Acræa* was captured in Mamba, Kilimanjaro, on September 25, 1905. The under side of the specimen differs entirely from that of the extremely abundant male and from other females of its group, in the overspreading fulvous tint which tends to obliterate the markings, producing at the same time a considerable superficial resemblance to the *fulvescens* form of *A. johnstoni*.

The *fulvescens* form, in addition to its mimicry of the *dorippus*, Klug, form of *Danaida chrysippus*, L., resembles the *daira* form of *Acræa encedon*, L. Both *dorippus* and *daira*, Godm. and Salv., are the dominant forms of their respective species. The local form of *Acræa doubledayi*, Guér., of which a male was taken on Kilimanjaro, January 26–31, 1906, also much resembles *daira* and *fulvescens*, and would probably be indistinguishable from these when upon the wing. E. B. P.]

[Address and date lost.

The two different forms of this [*Acræa johnstoni*] resemble other protected species, the commoner forms [*proteina* and *flavescens*] being very like *A. albimaculata* which

is common on the Taita hills: the other form [*fulvescens*] I thought to be a different species until I perceived that the white spots on the fore-wing were traceable though almost obsolete. It is very difficult to distinguish it from *Acræa encedon* on the wing, but it is I think both brighter and lighter in colour. It is more active than most Acræas, but shares with these their remarkable resistance to Potassium cyanide in the killing bottle.]

[*Mombasa*, April 5, 1905.

A. johnstoni I have only found on the hills at 3000 ft. upwards. I did not get it at Taveta, or indeed *A. albimaculata*, which also seems a hill insect.]

[It will be seen by reference to the table on p. 515 that soon after the above letter was written, forms of *A. johnstoni* were taken at Taveta. E. B. P.]

4. *Papilionine Mimics.* The mimetic females of the three species of *Papilio* are well shown, two-thirds of the natural size, on Plate XXVIII, together with their non-mimetic males and chief Danaine model. It is seen that the females of *Papilio jacksoni* (Fig. 2) and especially of *P. echerioides* (Fig. 4) are more perfect mimics of the *Amauris* (Fig. 1) than the *cenea* female form (Fig. 6) of *P. dardanus* (*merope*), probably sub-species *tibullus*. The latter happens to be a very imperfect specimen of a variety tending towards the *hippocoon* female form and rather a poor mimic. The series of specimens represented in Plate XXIV of this year's Transactions (1907) shows that the mimicry of the *cenea* form is usually better than in the example here figured. I have already alluded to the fact that all three *Papilio* mimics were taken at Nairobi on the same day (see Figs. 3, 5, 6 and 7 on Plate XXVIII), though one species (*P. jacksoni*) was represented by the male only which is not mimetic of *Amauris*. Another point of interest is the local preponderance of *Papilio jacksoni* where it is found. This preponderance at Kijabi is, I think, fairly represented by the series obtained there, and suggests that the *Papilio* may itself be distasteful to certain enemies, but gains advantage in the adoption by its female of a well-known Danaine pattern. Although a mimic, the *Papilio* may in its own habitat far outnumber the model, which however has a much greater range and is of course as a whole an infinitely more abundant insect.

In nature the *Papilio echerioides* female is much nearer

to the primary model than the other female Papilios, and, were it not for the characteristic habit of hovering nervously over a flower, it would be very difficult to distinguish it from the *Amauris*. This close resemblance is especially remarkable when it is remembered that the under surface is mimetic of a very different model—*Planema aganice*.

I have never met with the *cenea* form of the ♀ of *P. dardanus* sub-species *tibullus* at all frequently, although I have taken it at Taveta, e. g. on August 4, 1905. Furthermore, three specimens were brought me from Kilimanjaro, where it is probably common. Two of these are distinguished by the yellow colour of the disc of the hind-wing and some of the fore-wing spots, suggesting affinity with the primitive *trimeni*-like *cenea* female forms of *Papilio polytrophus* from the Kikuyu escarpment.

I have also received males of *Papilio echerioides* from the same locality and have taken them at Taveta and in Taita.

[*Mombasa*, April 5, 1905.

On Dabida [Taita] I have only taken *Papilio echerioides* above 3000 ft.]

It would be of great interest to obtain the female from these localities, but there can be no doubt that it is the same form as that captured in the Kikuyu country. Dr. Karl Jordan, who has seen the specimens, informs me that they are not quite the same as typical *echerioides* from Natal, Gazaland, etc., but are transitional between this and the Abyssinian sub-species, *oscari*, Rothsch. and Jord.

5. *Moth Mimics.—Aletis monteironis*, Druce, is an abundant species in North Kikuyu and, owing to its slow flight, a most conspicuous insect. It frequents more open country than the *Amauris*, but they may often be seen flying together. The resemblance is not strong on the wing, as the large pale areas of the moth are very prominent, and it is probable that it is itself a protected species, and has been but little modified by its association with the Danaine model.

(*a*) *Further Notes on Moth Mimics.* E. B. P.

The day-flying moth, *Aletis monteironis*, Druce, which looks so entirely different from the *Amauris* in the cabinet, is, Mr. Marshall informs me, quite a good mimic

of *Amauris lobengula*, E. M. Sharpe, when upon the wing. It occurs plentifully in British East Africa in localities where *Amauris echeria* and *albimaculata* are dominant. Thus I have received many from the neighbourhood of Fort Hall captured by my kind friends Mr. and Mrs. S. L. Hinde. Colonel Manders, who captured it with one of the *Amauris* models at Delagoa Bay, informs me that he thought it a good mimic on the wing, but when the set species were compared the very different patterns led him to conclude that he had made a mistake. The whole Geometrid genus *Alctis* is undoubtedly highly distasteful. Its ordinary pattern, e. g., that of *A. helcita*, Linn., of the West Coast and *A. libyssa*, Hopff., of the East, is probably the centre of an important combination (see p. 522) associated with that which surrounds *Danaida chrysippus*, but possessing strongly-marked independent aposematic elements of its own. In spite of these latter, the association with *chrysippus* has always been looked upon as synaposematic—a conclusion now strongly confirmed by this undoubted resemblance upon the wing of another species of *Aletis* to another Danaine model.

Aletis monteironis only differs from *A. libyssa* in the tint of the ground colour, a peculiar *ochreous* in the former, a brilliant fulvous in the latter. *A. monteironis* is probably a form of *A. libyssa* which has undergone a change in the tint of the ground colour in areas where the *echeria* (or *lobengula*) and *albimaculata* models are dominant. In spite of the special resemblance to *A. lobengula* observed by Mr. Marshall the distribution of the moth clearly indicates association with both the other allied forms of *Amauris*, viz. *echeria* and *albimaculata*. E. B. P.

III. *Danaida* (*Limnas*) *chrysippus-centred Combination in British East Africa.*

1. *The Primary Danaine model.* In East Africa generally the form *dorippus*, Klug (*klugii*, Butl.), is far more common than the type form, probably in the proportion of ten to one.

D. chrysippus seems very subject to the attacks of Dipterous parasites. Out of 10 pupæ which I bred from larvæ at Weithaga no less than 9 were destroyed by the larvæ of a fly, which has been identified by Mr. E. E. Austen as belonging to the genus *Blepharipoda*, of the *Tachinidæ*. These emerged on various dates in April,

1907. Thus my experience in British East Africa confirms that of Mr. G. A. K. Marshall in Rhodesia* and of Colonel J. W. Yerbury at Aden,† and supplies further evidence in refutation of Erich Haase's ‡ assumption that the immunity of specially protected forms is absolute and defends them from the attacks of parasitic foes as well as vertebrate enemies.

[*Taveta*, July 5, 1905.

D. chrysippus, for several months past, as far as I have seen, has been always of the *klugii* form, and I have not seen 6 specimens of the type form in 6 months.]

[*Rabai*, May 1, 1906.

Have you any reason to believe that the *klugii* form is spreading at the expense of the type form of *D. chrysippus*? It would certainly seem to be the case in this Protectorate. The great rarity of the type form which I noticed before is by no means confined to Taveta, but seems universal on the Coast district, where the climatic conditions are anything but those of a desert area. I doubt if I have seen half-a-dozen of the type form in the last $2\frac{1}{2}$ months, whereas the *klugii* form has been as common as usual.]

2. *Nymphaline Mimics. Hypolimnas misippus*, Linn., also abounds in British East Africa, but unlike the Danaine model, the proportionate number of the two females (*inaria*, Cr., and the type form) shows no marked preponderance on either side.

There are also two species of *Euryphene*—*E. senegalensis*, Herr.-Sch., and *E. chriemhilda*, Staud., both occurring in the Coast hills, the females of which seem at first sight to come into the *chrysippus*-centred association. Both species frequent shady places and are generally common where found. Both male and female of both species settle on the ground and on plants with their wings spread out. They differ somewhat in their preferences, *E. senegalensis* being generally found in cultivated country—banana plantations and such like—whilst *E. chriemhilda* affects the real forest country and is more local. In both species the female greatly resembles *L. chrysippus*, but on the upper side

* Trans. Ent. Soc. Lond., 1902, p. 338.

† Journ. Bomb. Nat. Hist. Soc., 1892, p. 209.

‡ Researches on Mimicry, Part II, English Translation, Stuttgart, 1896.

only; while the male, which is destitute of the black and white tip, cannot be said to mimic this Danaine. The habits of both Euryphenes are however markedly different from those of the other members of this combination. All these latter have a leisurely floating flight which increases the resemblance to the model. The Euryphenes, on the other hand, are characterised by a rapid skimming flight close to the ground, on which they are very fond of settling with their wings expanded. In such a position they are really very inconspicuous in the intense light and shade of the woodland and forest habitat which they prefer. They have moreover an under side which is evidently procryptic, and when sitting with closed wings they are exceedingly difficult to detect even when one has actually seen them come to rest. However, it is just possible that they may obtain some advantage from adopting a well-known aposematic appearance, and it is certainly difficult to account for the pattern of the female in any other way.

[*Mombasa*, Jan. 31, 1905.

I must say I have doubts about the species of *Euryphene* which resemble *L. chrysippus* being mimics at all. There are two species of this group in the Rabai district, of which one is common and widely distributed in the district [*E. senegalensis*], whilst the other seems much more local [*E. chricmhilda*]. Both of these have [in the female] the colouring of the type form of *L. chrysippus*, but their habits are totally different. They are woodland insects, and have a rapid skimming flight about a foot from the ground, on which they are very fond of settling, though they also settle not unfrequently on low bushes. They almost invariably settle with their wings expanded, and frequently remain in this position for a considerable time. In fact, their habits and haunts are so totally different from those of *D. chrysippus* as to make it exceedingly unlikely that they are in any true sense mimics at all.]

3. *Acræine Mimics.* *Acræa encedon*, L., is quite common everywhere, and the form *daira*, mimicking *dorippus*, is certainly considerably more abundant than the typical *encedon*. The *fulvescens* form of *Acræa johnstoni* with other convergent Acræas belonging to the *dorippus*-centred combination has been already considered on pp. 514–517.

4. *Papilionine Mimics.* *Papilio dardanus*, sub-sp. *tibullus*,

♀ form *trophonius*, Westw. This form of the female is far less common than the *hippocoon* form, but it does occur at Rabai, etc., and, as is well known, bears a remarkable resemblance to the Danaine model. Its flight is stronger and generally more lofty, so that it can be recognised on the wing, but in all other respects it is a very good mimic. A new form of the female from Nairobi is described by Mr. Roland Trimen in the Appendix (p. 554) under the name *dorippoides*. As its name implies it is a mimic of the *dorippus* form.

5. *Moth Mimics.* The Geometrid (*Boarmiinæ*) moth *Paraptychodes tenuis* should probably be associated with *D. chrysippus*, to which in general pattern it bears much resemblance. The moth is however, like the Euryphenes, a forest insect. I have taken it at Ndzovuni, near Rabai (July 21, 1906).

IV. *The Aletis-Euphædra Combination in British East Africa.*

I have not as yet encountered many of the members of this powerful association so closely related to the *chrysippus*-centred combination and yet distinguished by distinct and conspicuous characters of its own. The probable central model in British East Africa is distinguished in the British Museum, as *Aletis ethelinda*, Kirby, from the well-known south-eastern species *A. libyssa*, Hopff. The only apparent difference is the deeper richer tint of the fulvous ground colour in the examples of the more northern form in the National Collection. My own specimens however taken at Rabai (a male on Oct. 13, a female on Oct. 30, 1906) do not differ in this respect from the southern *Aletis libyssa*; and it is exceedingly doubtful whether *A. ethelinda* can be maintained as a separate species.

The only other member of the combination I have seen is *Euphædra eleus*, Drury, which I have once taken at Rabai in forest country.

B. Acræa-centred Mimetic Combinations.

These associations differ from those with Danaine models, because of the dominant place taken by synaposematic Acræas themselves, and consequently the smaller proportion of mimics belonging to other groups.

a. *A Planema-Acræa-centred Combination.*

Both at Taveta and Rabai the form of *Planema aganice*, Hew., which has been named by Dr. Butler *Planema montana*, is common. This form is characterised by the rich fulvous colouring of the male, the female coming into the black and white combination centred round *Amauris niavius* f. *dominicanus*, as referred to on pp. 507, 508. Associated with this species, but perhaps always less numerous, I took a form of *Acræa esebria*, Hew., called by Miss Sharpe *Acræa jacksoni*, which bears a strong resemblance to it, especially on the wing, where the details of the black and fulvous colouring would not be prominent. This form is considerably smaller than *Planema aganice*, but they are so much alike that it was some time before I realised that they were not the same species.

[*Rabai*, July 1, 1908.

I once took a *Pseudathyma* (possibly a new species), now in the British Museum, which quite deceived me on the wing. I took it for *A. esebria* until I had it in the net.]

[*Plymouth*, Jan. 2, 1908.

I may also refer to the obvious resemblance of a male *Pseudacræa** to the males of these two Acræines [especially the rich fulvous-marked *Planema montana*], although I have not myself taken this mimic. The single specimen (from Shimba) in the collection I sent to Oxford, was given to me. This *Pseudacræa* from Shimba is probably the male of the form allied to *P. hirce*, mentioned on p. 508.]

1. *Further notes on Planema-Acræa Combinations.*
E. B. P.

My kind friend the author has presented to the Hope Department the following specimens of *Planema aganice* f. *montana* together with the Acræas resembling it:—

Dabida (May 25—June 16, 1904): 2 ♂ and 3 ♀ of *montana*, all normal except one female with a pale ochreous instead of a white patch on the hind-wing. There are no specimens of *A. esebria* from this locality.

* *Pseudacræa rogersi*, sp. nov. See Appendix, p. 549.

Taveta (May 8, 1905—Jan. 30, 1906): 7 ♂ and 4 ♀ of *montana*, 2 of the females with the pale markings of a cream tint instead of white: 6 *A. esebria*, of which 2 resemble the males of *montana* and possess fulvous markings, the others pale ochreous.

Kilimanjaro (Jan. 26–31, 1906): 1 ♀ *montana*: 1 ♀ *Acræa carmentis*. The latter is white-marked and resembles the much larger female of *montana*.

In looking through the fine collection of butterflies from the Congo State in the Brussels Museum I was surprised to find that the form *montana* was abundantly represented from this area.

In Mr. St. Aubyn Rogers' experience *Acræa esebria* is less abundant than the *Planema*, and the above figures support this conclusion. In Southern Africa, on the other hand, the *Acræa* appears to be much commoner than *P. aganice*. There is however a similar mimetic relationship,—and the same is true of the representative forms of *Acræa* and *Planema* on the West Coast. Everywhere the *Acræa* seems to exist with the *Planema* and to act as a variable and unstable mimic. The far greater constancy of the colours of the *Planema* leads to the inference that it is the model and the *Acræa* the mimic. Varieties of the latter commonly diverge and become rough but undoubted mimics of *Danaida chrysippus*. There can be no doubt that the usual strong superficial resemblance between these two *Acræinæ*, combined with the divergence of *esebria* from the ordinary colouring and pattern of the genus *Acræa*, led to its erroneous inclusion for a time in *Planema*.

It is interesting to attempt to answer the question why *Planema aganice* acts as the model although it is, probably for the most part, a less abundant species. The reason is probably to be found in its greater constancy and also in its larger size. There are several other instances of mimetic associations between *Planema* and *Acræa*: in all that I am acquainted with the *Planema* is the larger insect and appears to act as the model. The dominance of a butterfly in the environment is affected by size as well as by numbers and other qualities: *cæteris paribus*, a large butterfly is likely to act as model for a small one. In a parallel instance from tropical America, the larger Nymphaline, *Colænis julia*, Fab., appears to act as model for the smaller Heliconine, *Eueides aliphera*, Godt., both

species swarming together over an immense range, and both probably equally distasteful. Evidence that *Colænis* is the model is yielded by a comparison of the northern and southern forms of both species. The northern *Eucides*, although diverging from the southern in the same manner as the *Colænis*, has not changed to so great a degree. In other words, the *Colænis* leads and the *Eucides* follows.

It is interesting to note that greater conspicuousness due to size may act in the same manner as greater conspicuousness due to pattern. *Amauris dominicanus* as contrasted with *A. echeria*, etc., seems to be an example of dominance due in large part to pattern. (See p. 432.)

These causes of predominant influence are of course relatively rare, the usual causes being greater unpalatability and superior numbers. Thus in nearly all the examples of mimicry figured in the four plates accompanying this memoir, the mimics are larger than their models, but the latter belong to the highly protected *Danainæ* and the genus *Mylothris*. The mimicry of the larger red and black Acræas by the immense *Papilio antimachus*, Dru., is a grand example of models far smaller than their mimic. There can be no doubt however that the models are here enormously more abundant and probably more distasteful than their gigantic mimic. In the case of *Planema-Acræa* and of *Colænis-Eucides* discussed above, there is not the same evidence for discriminating widely between the palatability and the relative abundance of the members of each pair. Their difference in size remains as an important distinction, and in both cases there is evidence that the larger species has acted as the model.

E. B. P.

b. *Red-and-black Combination centred by large Acræas.*

The commonest species in this group is *Acræa natalica*, Boisd., which is often very abundant, e. g. at Taveta. There are however several other Acræas which come into this group, though the distribution of the black spots on the red ground varies a good deal. These include *A. acara*, Hew., *A. anemosa*, Hew., *A. areca*, Mab., and *A. pharsalus*, Ward. Together with these must be associated the larger Nymphaline butterfly *Pseudacræa trimenii*, Butl., which is connected with the other species as regards pattern by *A. acara*, as regards size by *A. areca*.

Now although I have usually found *P. trimenii* a rare species, this is not the case at Rabai. In fact, in some seasons it is more common than any other member of the group with the single exception of *A. natalica*. It frequents much the same situations as the Acræas but its flight is more lofty and sustained, and when alarmed it goes off at a great rate. Still the integuments of the thorax are very tough and quite different from those of species which adopt a protective (cryptic) appearance. Although the specimens of *trimenii* from British East Africa differ in some details from the South African type, still they always have the brilliant pink and pearly white under side which at once distinguishes them from the nearly allied *P. boisduvali*, Doubl., in which the corresponding surface is ochreous.

[*Tavcta*, July 5, 1905.

Abantis tettensis, Hopff., mimicking on the under surface and at rest the pattern of the smallest Acræas of the *doubledayi* type, was quite common here in the rains in one place. It flies backwards and forwards with great rapidity quite in the usual skipper manner, and always settles with wings half-raised, so that it gives no idea of an *Acræa* on the wing or during the brief pauses between successive flights.]

1. *Further notes on Combination centred by large red-and-black Acræas.* E. B. P.

This group of large Acræas also includes *Acræa chilo*, Godm., captured by Rev. St. Aubyn Rogers in several localities. *A. astrigera*, Butl., not in his collection, but sent to me by Mr. and Mrs. S. L. Hinde from Fort Hall and Kitui, must also be regarded as a member, although apparently much rarer than any of the others. The group is furthermore perhaps united by its smallest members, *A. pharsalus* and small individuals of *A. natalica*, with the still smaller species,—*acrita*, Hewits., *bræsia*, Godm., *doubledayi*, Guér., and *neobule*, Doubl. The following table shows the numbers of specimens (with the inclusive dates) at Oxford captured by Mr. St. Aubyn Rogers at various localities in British East Africa.

	LOCALITIES.	DATES.	*Acræa acrita.*	*Acræa bravsia.*	*Acræa neobule.*	*Acræa doubledayi.*	*Acræa natalica.*	*Acræa pharsalus.*	*Acræa areca.*	*Acræa anemosa.*	*Acræa chilo.*	*Acræa acara.*	*Pseudacræa trimenii.*
The Coast district.	Mombasa	May 16—June 25, 1904.	...	...	...	...	...	...	1	...	...	1	...
		April 1, 1905.	...	...	...	...	...	...	...	2	...	...	...
	Rabai	May 28—Oct. 14, 1903.	...	..	...	1	1	...	2	1	...	1	...
		March 24, 1906—Jan. 21, 1907.	...	...	..	7	...	...	5	...	...	7	8
	Kalolein, Kaya Kauma, and Kowini	Feb. 21, 1903—Jan. 13, 1904.	...	5	...	...	1	...	...	...	6	...	...
		March 12, 13, 1906.	...	...	...	1	...	...	...	...	...	1	...
	Jilore, Mangea, Ndzovuni, and Mleji (Giryama)	July 16–24, 1906.	...	...	..	...	1	...	4	1	...	2	2
	Mwaeba Hill and Shimba	Nov. 25, 1904.	...	...	...	...	...	...	...	...	...	1	...
		Oct. 4—Dec., 1906.	...	...	...	...	2	...	...	...	...	1	...
Mazeras (Uganda Railway)		May 19, 1906.	...	...	...	...	...	...	...	1	...	...	...
Mackinnon Road (Uganda Railway) and Maketao		April 10—June 13, 1905.	...	1	...	...	...	...	...	...	2	...	...
Voi to Taveta		April, 1905.	..	6	...	...	...	...	...	...	1	...	...
Taita Plain, Dabida and Sagalla Mountains		May 25—Jun. 21, 1904.	4	1	...	...	1	1	2	...	2	3	...
Taita		May 26, 1905.	1	...	...	...	...	...	...	...	...	...	...
Taveta		April 13, 1905—Jan. 26, 1906.	3	16	8	1	19	...	...	1	...	1	1
Kilimanjaro		May, 1905—Jan. 31, 1906.	1	1	...	1	...	1	4	...	...	...	...
Totals		...	9	30	8	11	25	2	18	6	11	18	11

When the author was in England I asked him if he would kindly give me his general impressions of the relative abundance of the chief members of this important combination. At Rabai, *A. natalica* was the commonest, and then the following species arranged in the order of their abundance :—*Pseudacræa trimenii, Acræa acara, A. anemosa, A. areca.* At Taveta, on the other hand, where *natalica* swarms, the *Pseudacræa* was the rarest, and no definite impression remained of the relative numbers of the others. In the neighbourhood of Taita, *natalica* was the commonest species, and *areca* next, while the *Pseudacræa* was not seen.

It is important to bear in mind these impressions, founded on an experience going back to 1898, when studying the table printed above.

The relation of the eastern and western sub-species of *Pseudacræa boisduvali* to their respective Acræine models is interesting and peculiar. There can be no doubt that the eastern sub-species *trimenii* with its conspicuous sub-apical yellow-ochreous fore-wing bar, mimics *Acræa acara* (in which the apical portion of the fore-wing is warm reddish-ochre), and bears no very close resemblance to *areca* or to any of the other large red black-marked eastern Acræas. The western *boisduvali*, on the other hand, is a much closer mimic of *Acræa egina*, the western representative of *areca*, than it is of *zetes*, the representative of the eastern model of *trimenii*. This is all the more remarkable because *zetes* is replaced by *acara* in the Cameroons, as I was astonished to find in the collection of the Brussels Museum.

This mimetic relationship is unusual, and is all the more remarkable because the eastern mimic is transitional into the western, the eastern model into the western *zetes*, the western model into the eastern *egina*. It is probable that this curious relationship is to be explained by the fact that *acara* is, on the whole, predominant over *areca* in the range of *trimenii*, and *egina* (the W. representative of *areca*) predominant over *zetes* (the W. representative of *acara*) in the range of *boisduvali*. (Compare Mr. Roland Trimen's account on pp. 552–554.*)

A very interesting detail in the mimetic resemblance of the *Pseudacræa* is to be seen in the palpi, which are orange like those of *Acræa acara*, *A. areca*, *A. anemosa*, and *A. natalica*. A parallel case is to be found in the *Methona-Thyridia*-centred combination of tropical South America, in which the yellow or orange-clubbed antennæ of the models are mimicked by *Danainæ* (*Ituna*), *Pierinæ* (*Dismorphia*) and Castniid moths. In both cases the small size of the mimetic feature is probably compensated by its prominence. E. B. P.

c. *Combination of small fulvous and black Acræas from Weithaga.*

This group consists entirely of species of the genus

* Just as Mr. Trimen finds obvious links with the western *boisduvali* in the pattern of certain eastern individuals, and especially one of the Rabai specimens here referred to, so also a clear transition towards the eastern *trimenii* may be seen in Angolan specimens in which a trace of the ochreous sub-apical fore-wing bar is present. It is however probable that *acara* and not *zetes* is the Angolan form.

Acræa, i. e. *A. cabira*, Hopff.; *A. vinidia*, Hew.; *A. alicia*, E. M. Sharpe, and *A. terpsichore*, L. (*serena*, Fabr.), the latter being an outlying member.

In Northern Kikuyu it is the local species *A. alicia*, which is dominant in numbers. This species is by far the most abundant butterfly in the whole country, and I once counted 460 specimens which had settled for the night on one small tree. *A. alicia* flits restlessly round bushes and small trees, quite after the manner of some of the blues. They settle occasionally on the trees or on low herbage. The males are much the commoner. Although so different on the under side, I could not distinguish the males and females on the wing. The female of *A. alicia* is dimorphic on the under side, and the two forms bear a considerable resemblance on this surface to *A. cabira*, Hopff., and *A. vinidia*, Hew. (f. *tenella*, Rogenh.) respectively.

The captures of members of this group are recorded in the table prepared by Professor Poulton, on p. 530.

1. *Description of two mimetic forms of the female of Acræa alicia, E. M. Sharpe.* E. B. P.

Acræa alicia, E. M. Sharpe, new female form, cabiroides.

The distinguishing features of this form are confined to the under surface, which is alone referred to in the following account. The under surface of the hind-wing and of the apical region of the fore-, bears a strong superficial likeness to the same parts of the larger butterfly, *Acræa cabira*, Hopff. The broad bar crossing the centre of the hind-wing and to a less extent the sub-apical bar of the fore-wing tend to become very pale, often attaining a cream tint like that of the same markings in *cabira*. The wide and complex marginal markings much resemble those of *cabira*, the internal contour of the marginal band is a pronounced bay near the apical angle of the hind-wing, being strikingly similar. The sub-basal band of black spots of the hind-wing is strongly developed and often presents the appearance of an irregular double row, although the dark red colour which is conspicuous between the two rows of *cabira* is almost wanting. Within these spots the base of the hind-wing is of a greyish tint, as in *cabira*.

The features which distinguish *cabiroides* are thus con-

WEITHAOA.	*Acræa terpsichore (serena).*	*Acræa cabira.*	*Acræa vinidia.*	*Acræa alicia.*
1906.				
Aug. 9 . .	...	...	...	3 ♂ 2 W 3 ♀ *c.* 2 ♀ *t.* 1 ♀ *i.* } all W
Aug. 11 . .	...	...	...	1 ♀ *c.* W –
Aug. 13 . .	...	1 ♂ 2 ♀ W W	3 ♂ 1 W + 2 W	...
Aug. 15 . .	...	1 ♂ W	...	...
Aug. 17 . .	...	6 ♂ 5 W	...	...
Aug. 22 . .	...	2 ♂ W	5 ♂ 1 ♀ 1 W + W + 2 W 2 W –	1 ♂ 1 ♀ *c.* W –
1907.				
Feb. 19 . .	...	...	...	1 ♀ *c.* W –
March 7 . .	...	...	...	2 ♂ 1 ♀ *c.* W –
March 8 . .	...	...	...	1 ♂ W
March 12 .	1 ♂	...	...	1 ♀ *c.* 1 ♀ *t.*
March 14 .	...	...	1 ♀ W +	♂ in cop. with ♀ *t.* W
March 20 .	...	...	...	♂ in cop. with ♀ *c.*
March 23 .	...	...	2 ♂	...
March 25 .	...	...	1 ♀	...
March 27 .	...	1 ♀	2 ♂ 1 W –	...
March 28 .	...	...	...	1 ♀ *c.* W –
April 16 . .	1 ♀	...	...	...
April 17 . .	...	...	1 ♀ W	...
Totals . .	1 ♂ 1 ♀	10 ♂ 3 ♀	12 ♂ 4 ♀	9 ♂ 15 ♀

c = *cabiroides* ♀ form of *alicia* mimetic of *cabira* on under side.
t = *tenelloides* ♀ form of *alicia* mimetic form of the *tenella* form of *vinidia* on under side.
i = ♀ form of *alicia* intermediate between the above.
W + = wings considerably worn (not chipped or notched except very rarely).
W = moderately worn.
W – = little worn.
Specimens without W are fresh.

fined to the parts of the under surface which are visible at rest: they probably sub-serve Müllerian mimicry during repose. There can be no doubt that the resemblances in question are based on affinity: comparison between the *cabiroides* female form and *bonasia*, F., the western representative of *alicia*, makes this evident. But, at the same time, it is equally clear that in the presence of the British East African *cabira*, just those elements in the pattern have been retained, developed and modified, which would thereby promote resemblance during repose.

TYPE captured, March 28, 1907, at Weithaga, N. Kikuyu, British East Africa; in Hope Department, Oxford University Museum.

The *cabiroides* form was taken *in coitu* with the male *A. alicia* on March 20, 1907.

Acræa alicia, E. M. Sharpe, new female form tenelloides.

Distinguishing features are confined to the under surface which is alone referred to below. The under surface of this female form, which is apparently less abundant than *cabiroides*, superficially resembles that of the *tenella*, Rogenh. (=*abbotti*, Holland), form of *Acræa vinidia*, Hew., found abundantly in the same locality (Weithaga). As in *cabiroides*, the resemblance is confined to the parts of the under surface that are visible during repose. The sharp demarcation between the marginal markings and the paler ground colour is obscured by an over-spreading ochreous shade, producing an effect entirely different from that of the *cabiroides* form and its model, but somewhat similar to *tenella*, especially the females. The cream-coloured band crossing the hind-wing which is so conspicuous a feature in the *cabiroides* form, is here obsolete or invisible, being of a pale yellow tint like the rest of the disc. The marginal pattern is much reduced, the inner part with its bay, which is so characteristic a feature in *cabiroides*, being absent or only to be made out by careful examination. Thus reduced, the margin is only about half the width attained in the other mimetic female form, being of about the same proportion as in *tenella*, and like it with an internal contour nearly parallel with the hind margin of the wings, and with a bay which is slightly marked as compared with that of *cabira* and its mimic. The triangular yellow internervular markings which invade the border from the hind margin of the hind-wing resemble the similar orange

marks of *tenella*,—especially the female of this latter, in which the triangles are less prominent and less sharply defined. In *cabira* and in the most fully-developed *cabiroides*, these markings are of a cream tint and very conspicuous. In all characters hitherto mentioned except the overspreading ochreous shade the *tenelloides* form tends to assume the pattern of its own male, and it might be held that this and not the mimicry of *tenella* is the significance of the difference between the two female forms of *alicia*.

The pattern of the male is however extraordinarily sharp and conspicuous, while that of *tenelloides* is obscured and ill-defined, so that the two patterns, however similar they may prove to be on close examination, have an entirely different superficial appearance. Furthermore, the remaining important characters towards the base of the hind-wing diverge from the pattern of the male *alicia* and resemble those of *tenella*. The sub-basal black spots retain the appearance of a double row as in *cabiroides*, but are much reduced in size, while individual spots are lost, especially in the central or intra-cellular part of the series. The male, on the other hand, possesses an irregular single row of very heavily marked black spots, as well developed in the cell of the hind-wing as elsewhere. The points in which the band of *tenelloides* differs from that of its own male and from the other female form, bring about an approach towards the pattern of *tenella*, which can hardly be accidental. In both sexes of *tenella* there is an irregular double sub-basal row of small spots, of which the largest are a pair (one spot for each row) within the costal margin, while the most numerous form a group within the inner margin. Between these two extremities the rows are only represented by two spots in the cell, of which the outer is usually the more conspicuous and sometimes the only constituent. In the *tenelloides* form we also find the two prominent costal spots, the numerous small spots at the other end of the series, and the median reduction to one or two spots in the cell.

Tenella furthermore differs from *cabira* in the absence of a well-marked bluish-grey basal area within the sub-basal spots, a feature that is mimicked in the best developed *cabiroides* females and suppressed in the best developed *tenelloides*, where the area in question is, as in the model, rather darker than the rest of the under surface, but differs

from the model in the absence of basal orange marks, somewhat conspicuous against the yellow ground colour. *Tenelloides* appears to display more evidence of special adaptation and a smaller use of ancestral features in the attainment of a mimetic appearance, than *cabiroides.*

TYPE captured, March 12, 1907, at Weithaga, N. Kikuyu, British East Africa; in Hope Department, Oxford University Museum.

The *tenelloides* form was taken *in coitu* with the male of *A. alicia* on March 14, 1907.

These two female forms are probably specially developed in N. Kikuyu in relation to the abundance of *cabira* and *tenella.* I have not found the same sharp differentiation into two contrasted forms in the females from other localities which I have had the opportunity of studying. Very great variation in the under surface pattern of the females was however always evident; and even at Weithaga intermediate forms appear, while distinct traces of the *cabiroides* pattern, invisible at a little distance, can be made out on a careful examination of some of the *tenelloides* females. E. B. P.

2. *The peculiar aposematic pattern of the under surface in the male Acræa alicia.* E. B. P.

The visible under surface of the male of this species and the allied *A. uvui,* Grose-Smith, possesses a remarkable and characteristic pattern. The ground colour and apical bar of the fore-wing are bright yellow, the subapical bar of the fore-wing and the border of both wings deep black, the border containing prominent yellow markings, developed along the hind margins of both wings. The sub-basal row of black spots of the hind-wing is so strongly developed as nearly to form a continuous band, within which the ground colour assumes a greenish tint. The effect of the simple pattern thus briefly described is very peculiar and unlike that of other Acræas. E. B. P.

3. *The synaposematic upper surface pattern of Acræa alicia, uvui, etc.* E. B. P.

Although the females are so different from the males on the under surface, that of *uvui* resembling the *fulvescens* form of *Acræa johnstoni* (see p. 516), the pattern of the upper surface is very similar in the two sexes. The females of

alicia and *uvui* are indeed distinguished from the males by the pale markings in the black hind marginal border, but in spite of this are indistinguishable upon the wing (see p. 529). Mr. S. A. Neave, M.A., B.Sc., has called attention to this upper surface aposematic pattern and has pointed out that *Acrœa vinidia* (*tenella*) possesses a very similar upper surface (Trans. Ent. Soc. Lond., 1906, p. 219). E. B. P.

d. *Pardopsis punctatissima, Boisd., as a model.*

P. punctatissima is a very common widespread species in East Africa and there is generally associated with it a Lycænid, *Pentila amenaida*, Hew., and in other localities other species of the same genus. Both are woodland species, though the Lycænid prefers much more shady places than *P. punctatissima*. The latter is altogether duller in colouring and its flight is much nearer the ground.

When at Taveta I was much struck by the resemblance of a diurnal Geometrid moth, *Petovia dichroaria*, Herr.-Sch., which I took flying with *P. amenaida*, on December 9, 1905. The resemblance does not appear very strong in the cabinet, but on the wing the similarity of their flight and their general appearance is very deceptive, so much so that I have had difficulty in discriminating between the species in the living state. The moth is somewhat brighter in colouring than the Lycænid. *P. punctatissima* is commoner at Rabai than at Taveta, and *P. amenaida* is also abundant, but I do not remember seeing the moth.

P. amenaida gives one the idea of being itself protected. It is very fond of settling in little companies on low plants, and if disturbed often opens its wings a few times without quitting the surface on which it is resting. Its flight is very feeble indeed.

[*Rabai*, August 29, 1908.

I have lately taken *Pentila amenaida* and *Pardopsis punctatissima* together. Many specimens of the *Pentila* are smaller with the spots fewer and smaller, so as to bear little resemblance to the *Acræa*. Although the Pentilas are more addicted to forest country and the *Pardopsis* to grass-lands with patches of bush, they may be seen flying together. The *Pentila* is even commoner than the *Pardopsis*.]

1. *Further notes on the mimics of Pardopsis.* E. B. P.

It is probable that the Geometrid moth is a secondary Müllerian mimic of this specially protected Lycænid. Mr. Guy A. K. Marshall captured the same species at Malvern, Natal, flying with another distasteful Acræiform Lycænid—*Alæna amazoula*,* Boisd. Four examples of the moth and three of the *Alæna* taken by Mr. Marshall, September 26, 1897, are now in the bionomic collection of the Hope Department. These specimens of the moth are much paler in tint, and possess far darker veins than the individuals from Taveta, of which a second was taken by Rev. St. Aubyn Rogers on December 26, 1905. These local differences in the moth correspond to obvious points of distinction between the *Alæna* and the *Pentila*, thus suggesting the conclusion that the two *Lycænidæ* act as models. A much larger number of specimens from both localities must however be examined and compared before this conclusion can be regarded as established.

There is no doubt that both these Lycænids are mimics of the *Acræinæ*—the *Pentila* of *Pardopsis*, the *Alæna* of a general type of Acræine colouring—thus supporting the opinion that the resemblance of the moth is a case of secondary mimicry. I found that both *Alæna amazoula* and *Pentila amenaida* had been placed among the Acræas of the Hope Department by the late Professor Westwood. Unnamed and evidently unstudied they had been placed where almost any naturalist unfamiliar with their section of the *Lycænidæ* would have placed them if he had not the time to make a careful examination. E. B. P.

C. Mimetic Combinations among the Pierinæ.

I. *Mylothris-centred Combinations.*

a. *Mylothris agathina-centred Combination taken at Rabai.*

The following specimens were captured at Rabai, June 23, 1906 :—

Myl. agathina, Cram., ♂. See Plate XXIX, fig. 5, for under surface.

Belenois thysa, Hopff., ♀ : dry f. See Plate XXIX, fig. 6, for under surface.

* Trans. Ent. Soc. Lond., 1902, pp. 497, 498.

Leuceronia argia, Fabr., ♀: dry f. See Plate XXIX, fig. 7, for under surface.

All the specimens were in good condition except the *Mylothris*, which was slightly worn. These species are all fairly common at Rabai and are found frequenting the same stations. *M. agathina* is, perhaps, more distinctively addicted to the open country, but all are found in woodlands, and *M. agathina* and *B. thysa* may frequently be seen flying together.

In this district the commonest species is *B. thysa*, though the association is probably grouped round *M. agathina*, which has the slow leisurely flight of a protected species.

B. thysa has a much more rapid flight when disturbed, but, like most of the members of its genus, it is frequently seen settled on flowers, and it is comparatively rare to find specimens which show evidence of the attacks of birds.

L. argia is more of a forest insect, and the flight of the males is high and strong. The female usually flies much lower and much less strongly than the male, so that it approaches the other two members of the combination in habits as well as in colouring.

[The mimetic resemblance, which is developed upon the under surface of the wings, is represented on Plate XXIX, figs. 5–7. The orange flush at the base of the fore-wings which is the distinctive feature of the male *Mylothris* and the females of the other two species, is distinctly shown in the plate. The mimetic likeness attained by the female *Leuceronia* (Fig. 7) is seen to be very rough as compared with that of the *Belenois* (Fig. 6). Furthermore, the orange flush of the *Leuceronia* resembles that of the *Belenois*, and more closely that of the *Mylothris*, —probably due to secondary mimicry; but many specimens must be compared before this suggestion can be accepted. It is of much interest to note that the primary model resembled by these two females is a male, the orange flush of the female *Mylothris agathina* being obscured by the general brownish-orange colour of the wings. E. B. P.]

b. *Mylothris agathina-centred Combination from Kilimanjaro.*

Myl. agathina, Cram., 1 ♀ (worn, a large notch in left fore-wing), Jan. 26–31, 1906.

Myl. poppæa, Cram., 1 ♀, Jan. 26–31, 1906.

Myl. yulei, Butl., 4 ♀, Jan 5–16, 1906.

Myl. rüppellii, Koch, 1 ♀, Jan. 5–16, 1906.

Pinacopteryx rubrobasalis, Say, 3 ♀, Jan. 5–16; one, Jan. 26–31; two, 1906.

With regard to the upper surface *M. poppæa* is much brighter orange than the others. The other species of *Mylothris* resemble one another and are approached by the palest of the three specimens of the *Pinacopteryx*.

On the under side the palest *Pinacopteryx* beautifully mimics the *M. rüppellii*, while the other two specimens of the *Pinacopteryx* mimic *M. agathina*, in which the ground colour of the hind-wing is ochreous. The *M. yulei* and *M. poppæa* resemble each other closely.

The predominance of the genus *Mylothris* in this combination is very evident, and there is no doubt that it is distasteful to some enemies, at any rate. All the specimens were captured for me by natives, as I was unable to go to Kilimanjaro at that time. When I was on the mountain in September I observed the abundance of this combination and obtained specimens of some of its members.

c. *Mylothris-centred Combination from Weithaga.*

The table on p. 538 represents all the specimens of an interesting Pierine combination captured at Weithaga in the Northern Kikuyu country, a part of the Kenia province of the colony.

The most dominant species is *Mylothris rubricosta*, Mab., which is found almost exclusively in swampy places, and is also very abundant. *M. rüppellii*, Koch, is also found commonly, but I do not remember having ever seen *M. agathina* in this part of the Kikuyu country.

Associated with these is found *Phrissura phœbe*, Butl., of which the under surface of the female bears most resemblance to *M. agathina* ♂, whilst that of the male is nearer to both sexes but especially the male of *M. rubricosta*. On the upper side the female of *P. phœbe* is,

WEITHAGA.	*Mylothris rubricostata.*	*Mylothris rüppellii.*	*Phrissura phœbe.*	*Pinacopteryx pigea*, N. form of.
1906.				
Aug. 15 .	3 ♂ 5 ♀	...	...	...
Aug. 16 .	8 ♂ 2 ♀ Anal angles of both H.W.s notched in 1 ♀.	...	...	...
Aug. 18 .	...	2 ♂ Left wings of both cleanly shorn.	...	...
Aug. 22 .	...	...	1 ♂ Chipped.	1 ♂ Chipped, and specially at anal angle H.W.
Aug. 23 .	1 ♂	1 ♂ Left H.W. shorn.	...	...
Aug. 24 .	...	1 ♀ Worn, rather chipped.	...	...
1907.				
Feb. 13 .	...	...	...	1 ♂
March 9 .	2 ♂	...	...	...
March 13 .	1 ♂	...	...	...
March 19 .	...	...	...	1 ♂ Rather worn.
March 23 .	...	...	...	1 ♂ 1 ♀ (normal) Rather worn.
April 5 .	...	...	...	1 ♂
April 13 .	1 ♂	...	1 ♀	...
April 20 .	...	...	...	1 ♀ (mimetic) Fresh, chipped.
May 11 .	2 ♂ 1 ♀ Anal angle of one H.W. notched.	...	...	...
May 13 .	1 ♂	...	...	...
Totals .	19 ♂ 8 ♀	3 ♂ 1 ♀	1 ♂ 1 ♀	5 ♂ 2 ♀

however, much nearer to the two species of *Mylothris* captured with it, but especially to *M. rüppellii*, because of the development of the black markings.

The most interesting species of the combination, however, is the single female of the northern form of *Pinacopteryx pigea*, Boisd., captured April 20, which is quite different from the normal form and distinctly mimetic of the section of the genus *Mylothris* of which *M. agathina* ♂ is the best-known example. On the under side the

resemblance is strongest to the male of this species; but on the upper the likeness to the two species of *Mylothris* actually taken with it, and especially *M. rubricosta*, is more evident. This remarkable female of *P. pigea* chiefly resembles the female of *M. rubricosta* in the indistinctness of the orange-red flush, whilst the slight black margin brings it nearer to the male of the same species.

This form of the northern *P. pigea* has not been taken hitherto, and is, in Dr. Dixey's opinion, perhaps transitional towards *P. rubrobasalis*, Lanz.

It would be of considerable interest to ascertain whether this mimetic female is a seasonal form, and whether it is to be compared with the special development of mimicry in the dry season phase of *Belenois thysa*, as described by Dr. F. A. Dixey.* The seasons are not however well marked in Northern Kikuyu, and the country never reaches the parched state which seems necessary for the full development of the dry season phase of most *Pierinæ*.

It will be observed from the table on p. 538 that several specimens show injuries probably caused by the attacks of birds, and that this evidence is stronger in the case of *M. rüppellii*, although a model, than in that of the mimetic species. The cleanly shorn hind-wings of more than one specimen of *M. rüppellii* especially afford very strong evidence of attacks by such a weapon as the beak of a bird.

The great predominance of Pierine mimicry within and convergent towards *Mylothris* is well seen in the tabulated Weithaga specimens; for the only other Pierines captured at the same period in this locality were:—

1 *Belenois mesentina*, Cram.
6 *Synchlöe johnstoni*, Crowley.
2 *Terias brigitta*, Cram.
3 *Terias regularis*, Butl.
2 *Terias senegalensis*, Boisd.
3 *Colias electra*, Linn.

II. *Belenois-centred Combination from Taveta.*

Dr. Dixey has brought forward much evidence to show that *Belenois thysa* is a protected species, and, to judge from their abundance, it would seem that *Belenois severina*,

* Proc. Ent. Soc. Lond., 1906, pp. xxxvi, xxxvii.

Cram., and *B. mesentina*, Cram., should be regarded in the same light.

Whilst at Taveta it seemed to me that these two species formed a centre of convergence for other *Pierinæ*. On May 10, 1905, the following were captured :—

B. severina, Cram., ♀.
Teracolus halimede, Klug, ♀.
Teracolus celimene, Lucas, ♀.
Abantis levubu, Wallgr., ♂.

All these species bear a considerable resemblance on the wing, and all settle in exactly the same way with wings half raised. I think *Teracolus castalis*, Staud., might be added to the assemblage. The convergence is greatest between the ♀ *T. celimene* and the ♀ *B. severina*, and I have little doubt that the *Belenois* has acted as a model in this case. The other two species are more like the males of *B. severina* and *B. mesentina* ; and though in mounted specimens it may not seem very evident in the case of the *Teracolus* still it is very appreciable in nature. The Hesperid is of great interest, as mimicry in this group is so rare. The species has a rapid flight as is usual in this family, but its comparatively large size and its conspicuous black and white colouring mark it out at once from its congeners and give it a strong superficial resemblance to the forms mentioned above.

Teracolus has a habit of congregating in special places to roost every evening, generally several species being present at one and the same place, with the two common species of *Belenois*. These places are generally exposed to the rays of the sun as it sinks in the western horizon, and the same situations are used for months and even years.

[*Rabai*, Aug. 29, 1908.

As the rest attitudes of all butterflies are of some importance, you may be interested to hear that I twice saw *Belenois thysa* in the position of permanent rest. In one case a single shattered specimen was observed resting on the under side of the leaf of a small tree where it was well concealed, but two other specimens (quite fresh) were seen resting on the upper side of the leaves of a small bush in the forest with bright green leaves, against which the yellow under side was most conspicuous and could be

visible from some distance. At this time of the year very few butterflies are on the wing before 7 o'clock, whilst the early morning hours are a time of great activity for birds.]

[*Rabai*, Aug. 29, 1908.

Some of the smaller Acræas are anything but conspicuous on the under side,—even *A. encedon* which is so abundant and widely distributed. It is no doubt an advantage to them to be fairly well concealed in the position of complete rest.]

1. *Resemblance between a female Teracolus vesta and a female Belenois severina taken together at Taveta.*
E. B. P.

When looking over the *Pierinæ* captured by the author at Taveta, I noticed a female specimen of *Teracolus vesta*, Reiche (represented on Pl. XXIX, fig. 9), which strongly suggested the facies of the female of *Belenois severina*. When I turned to the series of this latter species, it was at once seen that on the very day (April 25, 1905) on which he had captured the *Teracolus*, a female *severina* closely resembling it had also been taken. The specimen is figured on Pl. XXIX, fig. 8. The pale salmon tint which usually appears on *T. vesta* is wanting from the upper surface of this specimen, of which the ground colour is a very pale greenish-yellow like that of the *Belenois*. The oblique black marking which starts from the costa of the fore-wing and crosses the end of the cell is strongly developed in the *severina*, closely resembling the *Teracolus*, in which it is a characteristic feature of the upper surface. Beneath, the yellow and orange tints and dark markings are very different in detail, but their general effect is the same. On the wing and at rest from a little distance, the butterflies would be indistinguishable. E. B. P.

D. Notes on the seasonal forms, etc., of Precis in British East Africa.

[This section is chiefly made up of quotations from letters by Rev. K. St. Aubyn Rogers, and noted on the specimens presented by him to the Hope Department.
E. B. P.]

a. Precis sesamus, Trim.

Rabai, Sept. 30, 1906.

I should have mentioned that I found *Precis sesamus* in Kikuyu (I had a month there during August 1906). All the specimens I took were the dry form, which is what one would expect; but I saw the wet form once. This year has been very wet in Kikuyu as well as at the coast, but the rains stopped in Kikuyu early in June, and I was there in the Dry Season: still the country was not at all dried up and the grass was still green. I doubt if it does dry up at this time of year in normal years. I also found *Precis archesia*, but those were all of the "*wet*" phase, which is rather extraordinary.

Plymouth, Jan. 3, 1907.

I do not think I have ever sent you the list of captures of *Precis sesamus* in North Kikuyu [Weithaga]. I have no record of those taken in Aug. 1906 [see preceding letter], but those of 1907 are as follows:—

1907.	DRY-SEASON FORMS.	WET-SEASON FORMS.
Feb. 16	1	3
Feb. 19	...	1
Feb. 22	1	1
Feb. 26	...	1
March 4	...	2
March 5	...	1
March 11	1	...
March 19	...	2
March 23	...	2
April 2	...	1
April 5	1	1
April 6	1	...
April 8	...	1
April 12	...	1
April 19	...	1
April 20	...	3
April 22	...	1

[The following list of Rev. St. Aubyn Rogers' captures at Weithaga differs in a few details from that given by him. The dates recorded below were copied from the "papers" in which the specimens were enclosed,

WEITHAGA.	DRY-SEASON FORMS.	WET-SEASON FORMS.	REMARKS.
1906.			
Aug. 9 . . .	1 C	...	...
Aug. 15 . .	1 W C	...	...
1907.			
Feb. 16 . .	1	2 1 W –	...
Feb. 18 . .	...	1 W + C +	...
Feb. 22 . .	1	1	The right hind-wing of dry form cleanly shorn as if by bird's beak.
Feb. 25 . .	...	1 W + C +	...
March 4 . .	...	1 W + C	...
March 5 . .	...	1 W	...
March 19 . .	...	2, 1 W + C +	The worn specimen is transitional towards the dry form: the other a fine fresh specimen.
March 23 . .	...	2 W + C +	...
April 2. . .	...	1	A very fine fresh specimen.
April 5. . .	1 W C +	1 W – C –	Both hind-wings of dry form shorn cleanly and symmetrically as if by a bird.
April 6. . .	1 C +	...	...
April 8. . .	...	1	...
April 12 . .	...	1 W C –	...
April 19 . .	...	1 W + C +	...
April 20 . .	...	2, 1 W – 1 W + C +	...
April 22 . .	...	1	...

The indirect evidence of injury inflicted on fresh or not greatly worn dry-season forms by birds, when the wet individuals so often exhibited strongly marked indications of ordinary wear and tear, may throw light on the bionomic value of the pattern of the phase to which the latter belonged. E. B. P.]

Rabai, July 1, 1908.

I have been up country again and have one more small contribution towards the elucidation of our old friend, *Precis sesamus*. I was at the Mukaa Hills, about 30 miles E. of Machakos, in the second week in June. You will perhaps remember that Hinde took about equal proportions of the two forms a little earlier than this at Machakos in 1900. The present season has been marked by deficient rainfall, and the heavy rains did not begin till April 20, which was very late.

The rainfall at Machakos for the first five months of 1900 and 1908 is quoted below, extracted from the Meteorolog. Records of the Agricult. Dep., B. E. A.:—

	1900.	1908.
Jan.	8·17 in.	0·80 in.
Feb.	8·10 in.	0·74 in.
March	10·15 in.	1·45 in.
April	5·43 in.	5·35 in.
May	5·89 in.	2·81 in.

The result of this late commencement in the present year is well seen in the series I have taken. *P. sesamus* was very common, but I only saw *one* dry form, which I took—a very fresh specimen. All the remainder, in all stages of freshness, were *Wet*, though one is a little intermediate. I think this is very remarkable, and may have some bearing on the stimulus. I should say that Mukaa is a dry place, and very open with little bush even. I searched the lower valleys and in the very sparse woods, but the single specimen was the only one I saw.

[The specimens obtained by Mr. and Mrs. S. L. Hinde are quoted below from Trans. Ent. Soc. Lond., 1902, p. 447, etc.

Machakos Road, May 22, 1900.—Twelve *P. sesamus*,—6 wet, mostly worn; 6 dry and fresh.

Machakos, June 6, 1900.—Six *P. sesamus*,—2 wet; 1 on the wet side of intermediate; 3 dry. All were fresh except one of the wet forms.

The comparison with Rev. St. Aubyn Rogers' captures is very striking, and the specimens collected by the same naturalist on Kilimanjaro in the autumn of 1905 should also be compared. See Proc. Ent. Soc. Lond., 1906, pp. lviii, lix, where the capture of many dry forms and a single wet is recorded. The latter, a fresh male, was taken Sept. 22, *in coitu* with a slightly worn and much torn dry female. The dry forms were mostly worn.

E. B. P.]

b. *Precis antilope.*

Rabai, 1906.

I spent a day or two in Taita on my way down, but the weather was not good, and I got nothing except on the march in to Voi, when I captured, among other things, the wet-season phase of *Precis antilope*,—the only example

I have seen * and one which may throw some light on the causes of the seasonal change.

The season should normally have been in the very height of the shorter dry season. But the seasons there are somewhat uncertain. Normally the smaller wet season is almost confined to November in Taita; after which comes the hottest and driest part of the whole year when insect life is at a minimum. The greater rains normally come about the middle of March or later. This year [1906] the rainfall in the latter rains was heavier than usual and lasted till much later. Moreover, there was heavy rain (5 inches or more) during the first week in February and I got the wet phase of *P. antilope* on the twelfth.

The falls are very local in these latter rains, and some places in Taita have suffered from a great deficiency of water, even this year, whilst in Taveta 50 miles away we hardly had any rain at all.

c. *Precis archesia, wet-season form pelasgis.* E. B. P.

The collection of this interesting and puzzling species from Weithaga was made during the following months:— 1906, August (7 specimens); 1907, February (2 specimens); March (4 specimens); April (4 specimens); May (1 specimen). It is not necessary to record the precise dates; for the whole of these, together with 7 Weithaga specimens, bred Feb.–April 1907, are of the wet form *pelasgis*, although falling short to a varying extent from the full wet forms of southern Africa.

Five eggs laid, Feb. 24, 1907, by a female on the wild food-plant were collected, although the parent unfortunately escaped. It was however a typical British East African wet-season female. The following table shows the very uniform length of the stages in the 5 individuals:—

EGG LAID.	HATCHED.	PUPATED	EMERGED.
1907.	1907.	1907.	1907.
Feb. 24	March 5	April 1	April 16
Feb. 24	March 5	April 1	April 16
Feb. 24	March 5	April 1	April 17
Feb. 24	March 5	April 2	April 18
Feb. 24	March 5	April 2	April 18

* The Hope collection contains a wet phase *antilope* captured by the author at Taita on May 26, 1905.

Two ova, of unknown parentage, were also found on the food plant. The larvæ which hatched from them pupated on April 5, an imago emerging on April 20, the other on the 21st.

These 7 bred specimens appear on the whole to show the *pelasgis* (wet) characteristics rather less fully than the majority of the captured specimens. This is especially true of the last-mentioned specimen, which emerged on April 21st. A comparison with the captured specimens renders it probable that these very slight differences are merely the result of artificial conditions, and do not indicate any tendency towards the development of the dry phase during April.

The chief character in which these more northern *pelasgis* approach *archesia* and fall short of the development attained by the wet-season forms in southern Africa is the usual grey-mottled appearance of the dark ground colour on the under surface, especially noticeable in the basal halves of both wings. In southern specimens, on the other hand, this dark ground colour is uniform and patternless. In other less striking features the northern forms appear also to approach *archesia*, but an account of them is postponed until a long series of southern specimens has been carefully examined from this point of view. In the meantime there is no doubt about the general existence of the important difference described above, and it is probable that the appearance of intermediate characters in the northern *pelasgis* may throw light on the evolution of the most completely specialised and contrasted seasonal forms of the species. E. B. P.

d. *Habits of Precis natalica and P. elgiva.*

Rabai, Sept. 30th, 1906.

I see [in Trans. Ent. Soc. Lond., 1902, p. 423] that in S. Africa *Precis natalica* and *P. elgiva* are both described as forest butterflies. This is not the case here. *P. natalica* is common at Mombasa even in parts of the island where there is no wood at all, and the scrub is not more than 8 ft. or 10 ft. high, and I found *P. elgiva* in N. Kikuyu where woods of any size are few and far between, and there is nothing that could be called forest anywhere near.

APPENDIX.

Description of new forms of British East African butterflies in the Hope Department, Oxford University Museum, chiefly collected by the Rev. K. St. Aubyn Rogers, M.A., F.E.S. By Roland Trimen, Hon. M.A. Oxon., F.R.S., F.E.S., &c.

Family NYMPHALIDÆ.

Sub-family *ACRÆINÆ*.

Acræa asboloplintha, Karsch,* *sub-sp. nov., rubescens.*

Exp. al. (4 ♂) 2″ 1—2‴; (1 ♀) 2″ 1‴.

♂. *Fore-wing*: fuscous ground of a clearer, less brownish but more ashy, tint than in typical form; black spots larger and more distinct; inner-marginal rufous, usually present in *asboloplintha* as a more or less obscure stripe from before middle to near posterior angle, is extended upward so as to form a median band, variable in development, and ill-defined on its edges, but intruding on discoidal cell and more or less filling space between sub-basal and medio-discal black spots. *Hind-wing*: deeper and brighter rufous; all medio-discal black spots—especially spots 1–4—larger, well-defined; hind-marginal fuscous edging much broader, its inner side not sharply defined but more or less diffused. Under side.—*Fore-wing*: rufous space of upper-side represented by a reddish tinge occupying a corresponding area; black spots more distinct and rather larger than in typical form. *Hind-wing*: black spots all larger; basal and inner-marginal red border more vivid, bright crimson; broad discal-submarginal fulvous band immediately beyond medio-discal black spots much deeper and brighter in colour; narrow hind-marginal yellow border also brighter.

Abdomen with much less rufous-ochreous on its terminal half, segments 4 to 9 being dorsally and laterally black, with a conspicuous upper-lateral series of ochre-yellow spots.

♀. *Dull-whitish* replaces in both wings the rufous of the

* Ent. Nachr., xx, p. 223 (1894).

♂; black spots as in ♂. *Forewing*: fuscous area duller and with a brownish tinge. *Hind-wing*: a very broad brownish-fuscous hind-marginal border, very diffused on its inner side. UNDER SIDE.—Very much duller and paler than in ♂ throughout, and but little differing from that of typical form ♀, except that median inner-marginal space in fore-wing is of a decidedly paler tint, in accordance with whitish area on upper side.

It is not improbable that the single ♀ of *rubescens* here described is not the normal form of that sex, but a second form of the kind not unfrequent in the genus, where white or whitish more or less suffuses or takes the place of the ordinary red or fulvous ground colour, usually in the hind-wing only.* The normal ♀ will probably be found to resemble the ♀ *asboloplintha* (which is of much duller and fainter colouring than the ♂), except as regards on the upper side a more rufous hind-wing, and a rufous median space in the fore-wing.

The ♂ *rubescens* obviously stands in much the same relation to ♂ *asboloplintha* as *A. acara*, Hewits., does to *A. zetes*, Linn., *A. cepheus*, Linn., to *A. eginopsis*, Auriv., *A. natalica*, Boisd., to *A. pseudegina*, Westw., and *A. areca*, Mab., to *A. egina*, Cram., *vid.*: that of generally brighter colouring and especially of rufous ground colour in the fore-wing instead of fuscous. This relation is associated with a different geographical range in the cases mentioned, the brighter forms being in three instances East and South-East, and the obscurer West African, linking gradations occurring in the intermediate areas; but *rubescens* and *asboloplintha* are found side by side in British East Africa, as are also *areca* and *egina* in Nyassaland.†

The isolated position, as sole representative of a sub-group of his second group of the genus *Acræa*, assigned to *A. asboloplintha* by Aurivillius,‡ does not seem to me to be a natural one, its respective neighbours assigned on either side being *A. satis*, Ward, the last species in sub-

* In a striking variety (*A. pseudolycia*, Butl.) from Congo and Angola of *A. acara*, Boisd., the entire field of both wings—except an ill-defined yellow-ochreous band just before hind-marginal black border of fore-wing, is pure white in both sexes. *A. albo-radiata*, Auriv., the very close Zambesian ally of *A. anemosa*, Hewits., also presents in both sexes some broad pure-white sub-apical rays in the fore-wing, and a large pure-white discal space in the hind-wing.

† Aurivillius, "Rhop. Æthiop.," pp. 508–10 (1899).

‡ *Op. cit.*, p. 90.

group II, and *A. zetes*, Linn., the first species in sub-group IV. I consider that, notwithstanding the extreme attenuation of the upper side hind-marginal border of the hind-wing, the disposition of the spots throughout, and also the broad unspotted fulvous discal-submarginal band of the hind-wing under side—though this feature is developed with exceptional prominence,—bring this form into much closer approximation to *A. stenobœa*, Wallengr., and in a less degree to *A. aglaonice*, Westw., and *A. caldarena*, Hewits.

The new sub-species *rubescens* here described inhabits British East Africa, and the 6 ♂ and 1 ♀ in the Hope Department of the Oxford University Museum, all bear the following data, viz. "About 6000 ft., 15 m. W. of Ft. Hall, Kikuyu Co., Weithaga, capt. and pres. 1907, by K. St. A. Rogers." The tickets further note the dates of capture, *vid.*: of the 6 ♂, Aug. 15, 1906, Feb. 15th and 22nd, and March 12th, 15th and 25th, and of the ♀, March 15th, 1907.

Type of male captured March 12, 1907, of female captured March 15th, 1907, both from Weithaga, in the Hope Department, Oxford University Museum.

Specimens of typical *asboloplintha* in the same Museum bear records of capture in the Tiriki Hills, 20 m. N. of Kisumu (C. A. Wiggins) and on W. shore of Victoria Nyanza, 60 m. along Anglo-German boundary, (1° S. Lat.) (Captain T. T. Behrens, R.E.), all dated as taken in March 1903; and others, in my collection, were captured by Mr. C. W. Hobley at Kaimosi and Nandi on different days during February and March, 1903.

Sub-family *NYMPHALINÆ*.

Pseudacræa rogersi, sp. nov.

A near ally of *P. eurytus*, Linn. (*hirce*, Drury).

Exp. al. (♂) 1″ 7‴; (♀) 3″ 1 ‴.

♂. *Fuscous, with yellowish-rufous areas, with black basal and sub-basal spots, and black nervules and internervular rays. Fore-wing*: black spots of the usual number, size, and arrangement; apical area not so dark as rest of ground colour, slightly suffused with grey; sub-apical rufous bar more median than in *eurytus*, considerably broader and longer, not straight but markedly incurved

inferiorly, extending from costal nervure to 1st median nervule where its termination is much narrowed ; on its inner edge this bar anteriorly includes the upper angulated corner of discoidal cell, but is considerably indented at origin of 3rd median nervule; inner-marginal rufous space extends much nearer to base than in *curytus* and up to median nervure, but is much reduced superiorly, rising only a little above first median nervule ; black internervular rays more apparent in apical area owing to the slight greyish suffusion. *Hind-wing* : rufous area greatly enlarged, occupying all the field except a moderately broad inwardly somewhat diffuse fuscous hind-marginal border of almost even width but slightly wider towards anal angle, and a narrow costal ashy-fuscous border from base to about middle; internervular black rays penetrating rufous field much less developed than in *curytus,* becoming very finely linear at a little distance from inner edge of fuscous border. UNDER SIDE.—Very dull and very much paler ; fulvous markings of upper side appearing as faint ochrey-yellowish in fore-wing and as dull-whitish in hind-wing, exteriorly ill-defined ; apical-hind-marginal areas brownish, in fore-wing clouded with whitish-grey, with the blackened nervules and internervular rays more linear than on upper side ; black spots of basal areas conspicuous. *Fore-wing* : discoidal cell grey, but narrow space of ground colour between sub-apical bar and inner-marginal marking pale fuscous. *Hind-wing* : basi-costal border much widened (but not diffuse and ill-defined as in *curytus*), reddish-brown.

♀. *Fuscous ground darker than in* ♂, *almost black; fulvous markings of* ♂ *replaced by pure white ones. Fore-wing* : sub-apical bar straighter and broader than in ♂, but a little shorter—its lowermost spot being reduced by about half, so that it terminates about midway between 1st and 2nd median nervules ; the inner edge of this bar does not at all encroach on discoidal cell, but it emits a rather acute dentation between lower radial and first median nervules; inner-marginal white space very much reduced in comparison with the corresponding rufous marking in ♂, except just along inner-marginal edge, scarcely rising to first median nervule, beginning far from base, and with its outline diffuse and ill-defined. *Hind-wing* : hind-marginal border broader and more even than in ♂ ; internervular black rays more strongly marked. UNDER SIDE.

—Ground colour much darker; white markings of upper side conspicuously reproduced; internervular black rays better developed. *Hind-wing*: basi-costal border fulvous.

Type of male from 16 miles west of Shimba, near Mombasa, about 1200 ft. Type of female from Rabai, July 28, 1906. The above description was made from these two specimens in the collection of the Hope Department of the Oxford University Museum.

The differences from the West African *Pseudacræa eurytus*, L., presented by this interesting new congener consist mainly in the reversal in the fore-wing of the relative development of the sub-apical bar and the inner-marginal patch, and in the very much greater development of the central patch in the hind-wing. There can, I think, be no doubt that these features indicate very clearly the mimetic approximation of the just-described East African ally of *eurytus* to the common Acræine, *Planema montana*, Butler,* of the same region. *Ps. eurytus*, as is well known, mimics to perfection the abundant *Planema epœa*, Cram. (*gea*, Fab.), of Western Africa, reproducing in each sex the narrow sub-apical bar and high truncated inner-marginal patch of the fore-wings, and the narrow sub-basal patch of the hind-wings, with much exactness both in form and colour. *Ps. rogersi* ♂ has not attained the same close imitation as far as the fore-wing markings are concerned, the retention of an inner-marginal patch diminishing the likeness to *Pl. montana* which has undoubtedly been gained by the quite peculiar position, curvature, prolongation, and inner indentation of the sub-apical bar; but it is very noticeable that—as in many other cases of mimicry—the ♀ *rogersi* has proceeded further on the mimetic path, the inner-marginal patch in the fore-wings having reached almost as reduced and evanescent a stage as in the ♀ *Pseudacræa imitator*, Trim., in her simulation of *Planema aganice*.

The members of the *eurytus*-group of *Pseudacræa* stand out most prominently among mimetic butterflies in the

* Aurivillius (Rhop. Æthiop., 1899, p. 121) has treated this form as a Variety of the South African *Planema aganice*, Hewits.; but, considering how very closely allied most of the recognised species of *Planema* are, it seems better to hold it entitled to species rank, because of the much broader bands in both wings—especially in the ♂, where they are moreover of a warm fulvous instead of yellowish or yellowish-white; in this sex also the basal area on the upper side of the hind-wing is strongly red-tinged.

persistency, exactness, and completeness with which they reproduce the pattern and colouring of their models, the very variable and abundant *Planemæ*—the species of which, though few in number in comparison with the allied *Acrææ*, are very difficult to distinguish satisfactorily. Every variation in both sexes appears to be faithfully copied throughout tropical and sub-tropical Africa wherever the genus *Planema* prevails. Aurivillius (Rhop. Æthiop., pp. 530–1) has recorded eight instances in which this mimicry is palpable, and the case here noted is an addition to that list. The mimicry mentioned by Mr. S. A. Neave (Novit. Zool., xi, p. 333, 1904) of the British East African form of *Planema tellus*, Auriv., by *Pseudacræa terra*, Neave, —captured on the same day at Entebbe—is another recorded instance; and, looking to the rather dull and unattractive aspect of these butterflies, and to the evident comparative rarity of the *Pseudacrææ*, it may reasonably be conjectured that they have not been very assiduously observed or collected, and that the extension of field research will bring to light more mimicries between members of these two genera.

It is a pleasure to name the species here described after the author of the very interesting memoir to which this is an appendix, not only in recognition of his valuable services to African entomology, but in view of his having himself (see above, pp. 508 and 523) pointed out the mimetic relation existing between this *Pseudacræa* and *Planema montana*. Mr. St. Aubyn Rogers has recorded that the ♂ of the *Pseudacræa* was sent to him from Shimba ("16 miles W. of; about 1,200 ft."), while the ♀ was captured by himself at "Rabai, 14 m. N.W. of Mombasa, on July 28, 1906."

Pseudacræa trimenii, Butler.*

The intimate alliance of this form of *Pseudacræa* with the West African *P. boisduvalii*, Doubl., was recognised by me in 1869 (Trans. Linn. Soc. Lond., xxvi, p. 517), and afterwards better explained with the aid of fuller material in 1887 and 1889 (S. Afr. Butt., I, p. 298, and III, p. 405). I showed how closely in both sexes *trimenii*, the South-Eastern form, copied *Acræa acara*, Hewits., of the same region, just as *boisduvalii* mimicked the West African

* Ent. M. Mag., xi, p. 57 (1874).

Acræa zetes, Linn.* I also pointed out, how variable *trimenii* was in one important feature of its mimicry of *acara*, *vid.*: the sub-apical yellow-ochreous bar of the fore-wing, the gradation extending to its complete disappearance in some individuals (*P. colvillei*, Butler), and so far approximating to *P. boisduvalii*, but at the same time exhibiting no abatement in the distinctive feature of bright-red instead of fuscous ground colour in the fore-wing. Later on, in 1898, in the fine collection generously presented to me by my friend Mr. Cecil N. Barker, I found 2 ♀ *trimenii*, having the yellow-ochreous bar of the fore-wing only narrowly developed and mixed with white, but also exhibiting a fuscous suffusion (considerably darker in one example), so that the usual red of the fore-wing only appears near the base. This fuscous clouding gives these examples considerable resemblance to the ♂ *boisduvalii*, but it must be noted that the reduced red of the fore-wing is near the base, not near the posterior angle as in *boisduvalii*.

I am now able, through the kindness of my friend Prof. Poulton, to record the occurrence in a British East African series in the Hope Department of 10 ♂ and 1 ♀ (see the table on p. 527), of a ♂ *trimenii* from "Rabai, near Mombasa (K. St. A. Rogers) captured January 19th, 1907," in which the sub-apical bar of fore-wing is very much reduced and narrowed (while the red spots in the hind-marginal border of hind-wing are unusually large),—having the fore-wing fuscous suffusion largely developed, so that the usual red ground colour is obliterated except for a large sub-quadrate space at posterior angle as in *P. boisduvalii*, and a slight sub-basal trace. This example is a most distinctly intermediate link between the Western and Eastern forms under notice, and probably indicates another of the now rather numerous cases in which presumed distinct species of

* Haase (Untersuch. über die Mimicry, etc., 1893, p. 43, taf. 4, ff. 26–28) showed that *boisduvalii* mimicked *A. egina*, Cram., more closely than *A. zetes*, at any rate as far as the ♂ is concerned, that sex having a red patch along outer portion of inner margin of fore-wing, just as in *egina* ♂, and larger than is exhibited by *zetes* ♂, while in hind-wing larger black spots characterise both *egina* and *boisduvalii*. On the other hand, as regards the presence of red spots in the hind-marginal border of hind-wing, *boisduvalii* resembles *zetes* and not *egina*. It is noticeable also that in the feature last mentioned, the mimicking West African *Papilio ridleyanus*, White, similarly resembles *zetes* more than *egina*.

African butterflies are found to meet and intergrade in the Eastern equatorial belt.

The known range of *P. trimenii* is now a wide one, extending from Port Natal along the East Coast to Mombasa, and thence inland to "Taveta (K. St. A. Rogers), captured December 2nd, 1905" [♂ in Hope Department], and Kibwezi (C. W. Hobley) captured in April 1907.

Family PAPILIONIDÆ.

Sub-family *PAPILIONINÆ.*

Papilio dardanus, Brown, sub-sp. *tibullus,* Kirby, ♀ form. nov. *dorippoides.*

Exp. al. 3″ 8‴ (one example).*

Nearest to the ♀ form *trophonius,* Westw., *but with the warm-fulvous colouring of both fore- and hind-wings greatly extended,* causing a correspondingly large reduction and obsolescence of usual fuscous area in fore-wing, and a similar but less pronounced condition of the hind-marginal fuscous border in hind-wing. *Fore-wing*: fuscous restricted

* This expanse is decidedly greater than that attained by Kikuyu examples of the sub-species *polytrophus,* Jord., that I have measured, which vary (♂) from 2″ 10‴ to 3″ 5‴, and (♀) from 3″ 2‴–5‴. In size the new ♀ form *dorippoides* thus more approaches that of the Eastern sub-species *tibullus,* and of the Southern sub-species *cenea,* in which both sexes have an expanse varying from 3″ 7‴ to 4″ 3‴. Typical *P. dardanus* from West Coast is larger than any of its sub-species, both sexes expanding from 4″ to 4″ 6‴;—one very large ♂ from Fernando Po (with extremely wide black border to the fore-wings) attaining an expanse of 5″.

[I think that the sub-species is the Eastern *tibullus,* Kirby, and not *polytrophus.* The latter is found at the higher elevations. The two Nairobi specimens (about 5500 ft.), represented on Plate XXVIII, Figs. 6 and 7, are also much larger than *polytrophus,* while the male (Fig. 7) has the black hind-wing band of *tibullus* and not that of the former sub-species. It is probable that in the Nairobi district *tibullus* occurs at the lower elevation—about 5000–6500 ft., while *polytrophus* captured by Doherty is labelled 6500–9000 ft. There is little doubt that the two areas overlap, and that the two sub-species meet and freely interbreed; furthermore that the resemblance of *dorippoides* to specimens of *polytrophus* is to be explained thereby.

Since the above note was written, Mr. Rogers has informed me that a *trimeni* female form recently taken by him at Nairobi, belongs, he believes, to the large *tibullus* sub-species rather than the small *polytrophus.* E. B. P.]

to (1) a costal border, rather narrow and dark as far as end of discoidal cell, but expanding (with a considerable irroration of fulvous scales) from a little beyond cell to apex into a rather wide form, inferiorly bounded by fifth sub-costal nervule; (2) a very attenuated faintly marked hind-marginal edging, expanding to enclose the two very much enlarged spots of the ground colour between 3rd and 1st median nervules; and (3) a little sparse extra-cellular irroration indicating the position of the usual broad band separating sub-apical oblique bar (which is normally white, but sometimes fulvous as in the example under description, in the *trophonius*-form) from large patch occupying inner-marginal area;—also some sparse fuscous irroration about base and over basal two-thirds of cell; with the exception of the retention on costa of the pale yellowish and whitish origins of usual oblique disco-cellular streak and extra-cellular sub-apical bar, all the rest of the wing is occupied by warm-fulvous—the two markings just mentioned being much enlarged, and, except as regards their costal portions, completely merged and confluent with each other and with the general fulvous area. *Hind-wing*: costal border pale yellowish shading into fulvous field a little below sub-costal nervure and its 1st nervule; hind-marginal border unmixed fuscous only between apex and radial nervule, the rest being closely irrorated with fulvous; all the enclosed internervular paired spots very much enlarged and (with the exception of 1st and 2nd pairs which are creamy-whitish) of the fulvous ground colour. UNDER SIDE.—Fulvous area much as on upper-side, but apical and hind-marginal border of fore-wing ochre-yellow instead of fuscous, and a rather wide basal space of hind-wing, from costa to inner margin, pale yellowish. *Fore-wing*: fuscous costal border in cell inferiorly better defined than on upper side, and extra-cellular discal fuscous irroration closer and darker. *Hind-wing*: pale yellowish basal space extending to extremity of cell, slightly irrorated with fulvous about base, along ordinary dark cellular longitudinal streaks, and on outer edge; succeeding it a ferruginous-fulvous discal band, very narrow costally but widening greatly to inner margin, externally blending with the ill-defined inner edge of the hind-marginal border, which is of a slightly greyish-ochreous, with its enclosed paired spots faint and blurred, but enlarged and coloured as on upper side.

This remarkable and most interesting form of the highly polymorphic ♀ of the *tibullus* sub-species of *P. dardanus* is in the Hope Department, and has been most kindly entrusted to me for description by Prof. Poulton. This, the type of the new form, bears the following record :—"1893, Nairobi. C. F. Elliot captd. Pres. 1906"; and it was presented to the Hope Department by Mr. E. A. Elliott, F.E.S., brother of the captor. It quite unmistakably mimicks the *dorippus*-form of *Danais chrysippus* so numerous in British East Africa. One was led to expect as not improbable the discovery of such a form of the ♀ *Papilio* from the fact that in all the continental-African races of *P. dardanus* in which the *trophonius*-form of ♀ occurs a variation has been met with presenting a partly or wholly fulvous instead of white sub-apical bar in the fore-wing, and so in some measure approximating to the *D. dorippus* coloration.* But the non-existence in Western and great rarity in Southern Africa of the *dorippus*-form of *D. chrysippus* rendered it very unlikely that the ♀ *Papilio* in those regions would include any close mimicry of that form, and induced the surmise that if this mimicry did exist, it would be found in that part of the *Papilio's* range where the *dorippus*-form equalled or exceeded in number the typical form of *D. chrysippus*. This view has now been verified by the discovery in British East Africa of the ♀ *Papilio* above described, in which the likeness to *dorippus* is gained by the extension and confluence of all the rufous-fulvous areas and minor markings, and the consequent diminution and suppression of the ordinary fuscous ground colour.

While it is observable that this likeness is not nearly so exact—especially in respect of the under side—as that exhibited by the ♀ *Diadema* (*Hypolimnas*) *misippus*, Linn., yet the fulvous tint is so very close to that of *dorippus* from the same district, and has so far invaded and occupied the hind-marginal borders, that the mimetic effect in life must be great. The resemblance to *dorippus* is in the example under notice so very much more advanced than in any other specimen of the ♀ *Papilio* known to me, that it would not be surprising if individuals still more accurately resembling the model should be found to exist

* See my note on this point as regards the Western and Southern races of the *Papilio* in "S. Afr. Butt.," iii, p. 252 (1889). Cf. Poulton, Trans. Ent. Soc. Lond., 1906, p. 290.

within the range of this Danaine's predominance or prevalence.

Everywhere exceptionally productive in differing forms and intermediate variations, the ♀ *P. dardanus* is surpassingly protean, as the smaller-sized sub-species *polytrophus*, in its modifications in the elevated interior of British East Africa, especially on the Kikuyu and other "Escarpments" immediately north and south of the equator. There, as Prof. Poulton has ably demonstrated,* it is possible to trace, with the aid of the many still existing gradations, the highly probable derivation of the more prominent mimetic forms from the primitive *trimeni*-form which is comparatively so little divergent from the male coloration and pattern. The transitional series from *trimeni*,—through (1) *hippocoon* and the partly fulvous-coloured linking variations between *trimeni* and *trophonius*; (2) those between *hippocoon* and *trophonius*; and (3) those between *trophonius* and *dorippoides*—well exemplified by the wholly fulvous-marked *trophonius* described by Prof. Poulton (l. c., p. 290);—constitutes a most striking and convincing illustration of the action of natural selection in the evolution of multiform mimetic adaptation within the limits of one sex only of a single species.

* Trans. Ent. Soc. Lond., 1906, pp. 283–298.

Explanation of Plates XXVI–XXIX.

[*See Explanation facing the* Plates.

XXIII. *On Müllerian Mimicry and Diaposematism.* A Reply to Mr. G. A. K. Marshall. By F. A. Dixey, M.A., M.D., Fellow of Wadham College, Oxford.

[Read October 21st, 1908.]

In dealing with my friend Mr. G. A. K. Marshall's most interesting paper (Trans. Ent. Soc. Lond., 1908, pp. 93–142), a large part of which consists of strictures upon views which have from time to time been put forward by me, I have in the first place to thank him for the courtesy which allowed me to become acquainted with his criticisms before these had been laid before the Society. I should wish also to say at the outset that I am sincerely glad that these criticisms have been offered. A theory is not likely to meet with much acceptance until it has been well scrutinised, and has run the gauntlet of adverse comment. The propounder of a new idea ought to welcome any fair objection that can be brought against his views. The worst fate that can befall him is to be passed over in silence; and even if the attack upon his position should prove successful, he has the satisfaction of knowing that at least he has helped to stimulate enquiry, and that the cause of truth has been the gainer. There is a reason for which Mr. Marshall's objections are specially welcome. We are likely to get from him as good a statement of his side of the question as can be made, and if so doughty an antagonist can be successfully answered, it is not likely that the theory which he impugns will have to meet any more formidable attack.

Let me now see what points I have in common with Mr. Marshall, and where exactly we diverge.

In the first place, it is clear that he may be claimed as a believer in Natural Selection and in the principle of Mimicry, both in the Batesian and Müllerian sense. With regard to the latter his words are: "There can be little doubt that a good many cases of mimicry originally adduced in support of Bates' theory must now be explained on Müllerian lines" (p. 93). So far I am quite in accord with him. Moreover, when he says that "the universal

application of this latter principle to butterflies . . . seems open to some serious objections" (*ibid.*), I can still give my assent. I have always held that there was room for both theories, which are complementary rather than contradictory. But having said so much, he proceeds to impose very serious limitations on the scope of Müllerian assimilation, and in especial to disallow the conception of what has been called Diaposematism or Reciprocal Mimicry, "even as a mere working hypothesis."

Here he no doubt expects me to join issue with him, and I shall not disappoint his expectation. I maintain, on the contrary, that the operation of the Müllerian factor, though not universal, is a good deal wider than he is disposed to admit; and that the principle of Diaposematism, which, as he rightly says, is a corollary of the Müllerian theory, affords the best explanation that can at present be given of certain interesting cases of mimetic grouping. This, I think, is a fair statement of the issue between us.

The General Argument.

The opening paragraphs of Mr. Marshall's paper contain a fair and lucid presentment of the Müllerian theory. On these passages I have naturally no criticism to offer, though it may be worthy of notice, in passing, that while the fact that young insectivorous animals have to undergo an education in the matter of suitable provender is, as Mr. Marshall says, "sufficiently well established by now" (pp. 94, 95), we cannot eliminate the operation of inherited instinct from the general relation of animals to their food. The avoidance of poisonous fruits, for instance, must, it would seem, be due to an instinct which has grown up under the influence of natural selection. This point, however, though it is well to bear it in mind, is immaterial for present purposes.

The first of Mr. Marshall's assertions that I should question is his statement on p. 95 that the initial mimetic variation must gradually replace the original form. It is hard to see why this must necessarily be the case. The original form may quite conceivably continue to be able to maintain itself, even after it has given rise to a variation which is also capable of a separate existence. Innumerable instances of this persistence of an ancestral form are known throughout organic nature, and indeed they are common enough among the special subjects of our present study.

The variation simply fits into a new place, leaving its ancestral stock to keep on in the old one.

Mr. Marshall goes on to point out (p. 96) that "the mental attitude of the enemy towards its prey has an important bearing upon the results which its attacks will produce." Upon this statement, which is no doubt true enough, he bases the conclusion that "those enemies which have a comparatively low degree of intelligence, and which therefore require to make many experiments . . ." operate more efficiently as producers of Müllerian mimicry than those enemies whose superior intelligence enables them to "profit more quickly by their experience." But, he goes on to say, "if there be enemies still lower in the scale and incapable of forming such a mental association [between colour and inedibility] at all, then the destruction of butterflies which they would cause would have no effect whatever from a purely mimetic standpoint." It would be interesting to know whether Mr. Marshall is prepared to indicate the exact point in the descending scale of intelligence at which will occur the transition from the greatest efficiency in the production of Müllerian mimicry to no efficiency at all. Moreover, although the more intelligent enemy will doubtless learn its lesson more quickly, it may also, as Mr. Marshall points out in the next paragraph, discriminate more readily and therefore experiment more freely, the two tendencies acting to some extent in opposite directions.

With regard to Batesian mimicry, it does not seem altogether clear that superior intelligence operates quite as Mr. Marshall thinks it does. It may, on the one hand, as he says, enable the enemy to discriminate between mimic and model; but, on the other, it may also assist its possessor to recognise a warning sign which would be passed unnoticed by an enemy of lower mental equipment. It would not be easy to say for certain whether a close mimetic resemblance is an appeal to superior cleverness or superior stupidity. For such reasons as these I feel doubtful as to the validity of Mr. Marshall's expectation "that the elimination due to the Batesian factor would be competent to produce a higher degree of inter-resemblance than would the factor adduced by Fritz Müller."

In his next paragraph Mr. Marshall deals with a possible difference in the periods of incidence of the two mimetic processes. I am not sure that his account of the effect of

the change of seasons can be taken as exact for all regions where the phenomena of mimicry obtain. For the country that has been the scene of his own admirable observations he can of course speak with the highest authority. But he appears to have left out of account the fact that it is not merely a question of young birds, but also of the emergence of new insects. The seasonal forms of butterflies are often so different from one another that a fresh brood may have to be learned as if it were a new species. Again, although in a given locality the insectivorous migrants may have departed, it is only to resume their activity among the insect provender, possibly quite new to them, of some other district. However this may be, the contention that the Müllerian factors vary in importance with the time of year, whether well-founded or not, does not seem to be very material for the points at issue.

We now come to an important section of Mr. Marshall's paper, in which on the strength of some very clever *a priori* reasoning, he asserts (I quote his words) that "a Müllerian approach will only take place in one direction, namely, from a rarer species towards a more abundant one, and no species can in this way approach another which has fewer individuals than itself." Equality (of number) he says, is "a condition which effectually prevents the Müllerian selection from producing any mimetic results" (p. 100). This contention rests principally on the arithmetical working out of certain supposed cases.

Before dealing specifically with Mr. Marshall's arithmetical demonstration, I would remark that experience shows the danger of trusting too much to *a priori* reasoning in matters of this kind, especially when its results do not accord with the facts of observation. In reference to an able treatise on a different subject,* lately published, it has been forcibly said that "readers are apt to assume that the statements are necessarily correct as being based on unimpeachable mathematical data. It will be well if they remember that mathematical deductions under the best conditions are like the flour that comes from a mill. If the original corn is impure, the flour will be unwholesome; . . . similarly arguments built up on insufficiently-observed phenomena, when subjected to the mill of mathematical reasoning, are exceedingly apt to have any faulty

* "Théories Modernes sur la Matière," by M. Pozzi-Escot.

observation magnified into grave and substantial error." * Or, as Huxley more tersely puts it, "mathematics will not give a true result when applied to erroneous data." As a single but sufficient instance, I would point to the history of a recent controversy.

Physicists, on what seemed to be very good *a priori* grounds, came to the conclusion that geologists and biologists had miscalculated the age of the earth. The biologists and geologists did not dispute the mathematical reasoning of the physicists, but they had confidence in their own facts, and they felt sure that there must be something wrong somewhere about the physicists' data. Their firmness has been justified; and the critics have now practically retired from the position that the geological clock wants altering.† Far be it from me to question Mr. Marshall's arithmetic. On arithmetical grounds which seem equally unassailable, it can be proved, as in the old logical puzzle, that if the tortoise once gets a start, Achilles will never catch him. What is the answer? *Solvitur ambulando.* We know that Achilles *will* catch the tortoise, arithmetic notwithstanding; and I venture to say that those who have fairly looked into the evidence know that Müllerian mimicry has taken place on a large scale, however difficult it may be to represent arithmetically the exact steps of its development.

Is there a flaw in Mr. Marshall's data? There are several flaws; as I shall show.

I shall begin by admitting that if in addition to his original assumption (pp. 97–98) we also allow him to suppose that the two hypothetical species are equally conspicuous, that they occur at exactly the same time, each form distributed at equal intervals throughout the same area, in which also their enemies are to be found with a similar evenness of distribution, and with a perpetually identical keenness of appetite, there is no doubt that the figures will work out nearly as he says; though even then it can be shown that there is a theoretical possibility of approach between two forms originally equal in numbers.‡

* "British Medical Journal," 1908, v. 1, p. 508.

† See Poulton, "Essays on Evolution," 1908: Essay on "The Age of the Earth."

‡ Because if the original number of each species, A and B, is x; the number of losses incurred by each species is y; and the number of A that assimilate themselves to B is n; the original chance of

But I venture to assert that this supposed case does not represent the usual, nor even a common condition of things in nature. This is no captious objection. I shall be able to show that Mr Marshall's supposed case, though interesting as an illustration of what might happen under certain conceivable circumstances, is valueless as a support of his position.

In the first place, he postulates, on the part of his two species of butterflies, A and B, the possession of "nauseous qualities in about the same degree." But every upholder of Müllerian mimicry, so far as I am aware, is not only ready to admit, but is prepared positively to assert that distastefulness is relative; that it exists, like other means of defence, in degrees that may vary indefinitely from species to species. Any one who doubts this needs only to refer to the experiments recorded by Mr. Finn in the "Journal of the Asiatic Society of Bengal," 1895 and 1897, to say nothing of Mr. Marshall's own results as published in the present and former papers (Trans. Ent. Soc. Lond., 1902, pp. 297–390; also *supra*, pp. 128–130). This cuts at the root of the statement that "a Müllerian approach will only take place . . . from a rarer species towards a more abundant one, and no species can in this way approach another which has fewer individuals (and therefore a higher percentage of loss) than itself" (p. 100). On the contrary, there is every reason to think that inferiority in numbers may be more than compensated by a higher degree of distastefulness.

The fact that different kinds of insect prey possess the qualities of palatability or the reverse in different degrees, and that these qualities are also relative to the likes and dislikes of different enemies, is fully accepted and enlarged upon by Mr. Marshall in a later section of his paper (pp. 128–130). But the strange thing is that he does not recognise that this conclusion, so far from being alien to F. Müller's theory, must form an integral part of any

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survival of each member of both A and B is $\frac{x-y}{x}$, but the chances of survival after the defection of n are—

For each member of A, $\frac{x-n-y}{x-n}$;

For each member of B (including the variety of A), $\frac{x+n-y}{x+n}$;

the advantage of B over A of course increasing with increasing values of n.

adequate account of the Müllerian conception. He has no warrant, so far as I am aware, for the statement that "in practice, the application of the Müllerian interpretation involves the assumption of a uniform standard of inedibility"; a statement which amounts to saying that any disparity of loss suffered by the less distasteful form involves the exclusion of the Müllerian factor from any assimilation it may acquire to the more distasteful. We can imagine that the frontier-line separating the operation of the two principles, though distinct, is fluctuating; but this does not justify any one in claiming the whole territory, up to the point of absolute equality of distastefulness, as an exclusive sphere of influence for the Batesian factor. In this and in other respects, Mr. Marshall's criticism, so far as it is effective, is directed not against the Müllerian theory itself, but against an imaginary position which has been erroneously endowed with the Müllerian name.

There is a further factor which has an equally disturbing effect with relative distastefulness on these numerical calculations. It is that of relative conspicuousness. A species poorly off in point of numbers may well suffer less than a more abundant form by dint of possessing a pattern which is more striking and so more easily remembered. A further complication is afforded by the varying habits of different species. It is by no means the case that all distasteful butterflies take every means of advertising themselves. There are differences between them in this as in other respects. As Mr. Marshall has mentioned the Erycinidæ * in this connection (p. 133), I commend to his notice the instructive case of *Hades noctula*, Westw., an abundant insect which there is every reason to suppose has acted as a model, but which nevertheless settles habitually on the under side of leaves.† If, as is quite possible, frequency of repetition is a factor in the rapidity with which insectivorous animals learn their lesson (a suggestion first made to me in a private letter by Mr. W. F. H. Blandford), a distasteful insect with habits of concealment might be more strongly influenced in the Müllerian direction than a species with great powers of advertisement though inferior in numbers. So far as

* Mr. Wallace's paper appeared in the Trans. Ent. Soc. Lond. for 1853; not 1863, as stated by Mr. Marshall.

† See Godman and Salvin; Biol. Centr. Amer., Rhopal., I, p. 374.

Mr. Marshall has dealt with this point at all, he has relegated it, like the former one, to the closing passages of his paper: and here again his argument suffers by reason of the exclusion from consideration, in its appropriate place, of what is really an important matter to be kept in view by all who would gain a clear and comprehensive grasp of the Müllerian hypothesis.

These then are the main reasons why Mr. Marshall's dictum about relative numbers cannot be accepted. Nor can we very well amend his arithmetical presentation of the case by restatement unless we assign numerical values, which can only be hypothetical, to the factors which he has omitted.

I think it will be seen that that part of the contention which depends merely on relative numbers must be withdrawn, and that my opponent must take his stand, if at all, upon the relative percentage of loss. A difference between species in this respect, by Mr. Marshall's own showing, will tend to the production of Müllerian mimicry; so that the only point on which I need join issue with him is his statement that "equality [in this case meaning an equal percentage of loss] effectively prevents the Müllerian selection from producing any mimetic results" (p. 100). The force of this contention is much weakened when we remember that there is no reason why the percentage of loss should remain constant while the individuals of a given form increase or diminish in number. In fact, from Mr. Marshall's own statement (p. 99) that "Müller's hypothesis postulates that the absolute destruction is practically constant for each group of different colours," it follows that the *percentage* loss must necessarily vary with every variation in the numbers of the group. Hence, as has been shown above (p. 563, note), Mr. Marshall's conclusion, even on his own data, is not quite correct. But there is still another factor to be taken into account which is sufficient to dispose of the objection altogether.

The supposed examples of distasteful butterflies, A and B, by hypothesis owe their survival to the possession of warning characters which are ultimately learnt by enemies and avoided when these latter have become sufficiently experienced. To employ Prof. Poulton's useful term, A and B are each of them provided with an aposeme; A's aposeme, also by hypothesis, being different from B's, and the two not being liable to be mistaken for one another.

Still keeping to the supposed case, and bearing in mind that A and B are each of them originally suffering the same percentage of loss, we find a certain number of A varying in the direction of B, that is to say, exhibiting an aposeme which is sufficiently like that of B to be confused with it. B and the variety of A, which we will follow Mr. Marshall in calling A′, now form, so far as B's aposeme is concerned, a homogeneous and mutually protective assemblage. But in adopting more or less of the aposeme of B, A′ has not necessarily lost hold of its original aposeme, and in every case where this is retained in recognisable form, A′ will share in the protection afforded by both aposemes, and will therefore have an advantage over both A and B, which by hypothesis are not mutually protective.

It will probably occur to any one who considers this point, that there must be a strong tendency towards the production and preservation of intermediate forms, stronger in the first instance than that towards the complete assimilation of one form to another. No doubt this is the case, and on examining actual instances we find plenty of indications of the operation of this principle. I shall have more to say on this head later on (see page 571), but it is incumbent on me, in the first place, to show how completely a recognition of the factor I am now discussing alters the whole aspect of reciprocal approach. I have implied already that I do not greatly favour the attempt to solve problems of this kind by means of numerical calculation; but Mr. Marshall has appealed to arithmetic, and to arithmetic he shall go.

We will suppose then, as Mr. Marshall does, two distasteful species, A and B, equal in numbers and distinct in appearance. We will also eliminate the effect of disturbing factors by supposing that the two species are equally distasteful, equally conspicuous and equally given to self-advertisement. Under these conditions the aposemes of A and B respectively will be learnt by the sacrifice of an equal number of A and of B; and as A and B are equal in population, this will mean that the percentage loss of each is the same. This is the state of things, reduced to its simplest expression, in which Mr. Marshall thinks that equilibrium will occur, and "the Müllerian principle will practically cease to operate altogether" (p. 99).

We will now express the case arithmetically. The actual numbers we take are immaterial, the only essential point

being that they should be the same for A and for B. Let us say a population of 1000 for each. Now we will suppose that a certain number of A vary in the direction of B, so as to show the aposeme of B in addition to that of A; and that a certain number of B similarly vary in the direction of A so as to show the aposeme of A as well as their own, this of course being what is meant by a reciprocal approach. The possibility of the occurrence of such variations is allowed by Mr. Marshall (p. 98); what he does not allow is the possibility of their permanent establishment.

Again, numbers are immaterial; to keep the illustration as simple as possible we will suppose that the given variation of A amounts to half the number of the species, and that similarly B is equally divided between its original form and its variation. We now have four classes, each 500 strong, which we may call A, Ab, Ba, B; the small letters being used to signify the presence of an aposeme that is adopted and not original. Now we will suppose that 100 young insect-eating birds are let loose upon the butterflies of these four classes. To eliminate Mr. Marshall's complication of X, Y and Z birds (pp. 103–105) we will suppose that all the butterflies are exposed to simultaneous attack by the whole body of their enemies. It is obvious that on an average each class will be attacked by 25 birds. For the sake of simplicity we will further assume that the butterflies are so nauseous, or the palate of their enemies so delicate, that one experiment on each aposeme is sufficient to ensure the exemption of that aposeme from further attack by the experimenter. Now let us see what will be the fate of our four classes. The 25 birds that attack A will not touch it again. Neither will they experiment on Ab and Ba, which exhibit the same aposeme. But each of them will experiment on B, which has nothing about it to suggest A's aposeme. Hence the result of the attack of batch No. 1 is the destruction of 25 A and 25 B. Batch No. 2 experiments on Ab, destroying 25 of them. But it will attack none of the other three classes, because each of these possesses an aposeme which it has learnt to avoid. Similarly the 25 birds (batch No. 3) that take toll of Ba will henceforth avoid all the rest, for the same reason. Batch No. 4 devotes its attention to B, which has already suffered, or will suffer, under batch No. 1. Of this class B, 25 will be taken, without supplying any experience for the benefit of A,

which latter class will therefore undergo a second exaction of the same number. The result of course is that the two original forms, A and B, each lose 50 individuals, or 10 per cent.; while the two diaposematic intermediates, Ab and Ba, each lose 25 only, or 5 per cent. Needless to say that in view of these considerations I have no intention of impaling myself on either horn of the dilemma so carefully prepared for me on p. 100 of my friend's paper.

It may possibly be objected that the numbers of Ab, Ba are not likely at the outset to be equal to those of A and B. This is true enough, but any one who is willing to incur the trouble can easily convince himself that taking the numbers of Ab, Ba smaller only accentuates their advantage over A, B. The number of individuals experimentally destroyed may of course be multiplied indefinitely without disturbing the relation between A, B and Ab, Ba.

But it may still be urged, is there any evidence that such intermediate forms as those exemplified in Ab, Ba are actually to be found in nature? Undoubtedly there is; about this I shall have more to say later on, but meanwhile we may take as a single example two forms of *Leuceronia* and *Nychitona* that occur together in the neighbourhood of the Victoria Nyanza. The former (*L. pharis*), though still unmistakably a *Leuceronia*, differs from its nearest allies by points in which it plainly approaches the *Nychitona*; while the latter, without losing its general resemblance to its own group, shows features of likeness to the *Leuceronia* which are peculiar to itself among its congeners. It may still be urged that there is no evidence of distastefulness in respect of these forms. This may be readily allowed without damaging the argument, for if such approach is possible between forms that belong to the edible category, it must be at least equally possible of occurrence between forms that are distasteful. And if it once occurs as a variation, its perpetuation is provided for in the manner already shown.

To summarise the foregoing:—Mr. Marshall has omitted to take into account the factors of (1) relative distastefulness, and (2) relative conspicuousness and powers of display. These omissions vitiate his argument as to the effect of relative population. Further, he has ignored (3) the effect of the possession of a double aposeme upon relative mortality, and (4) the fact that a persistence of a mimetic variation does not necessarily involve the disappearance of

the type. These omissions destroy the remainder of the foundation on which his *a priori* fabric is based.

But perhaps, after all, it was unnecessary to offer one's own reasons for dissenting from Mr. Marshall's conclusions, for he has himself made two admissions which virtually undermine his case.

The first of these is that, as he puts it with great candour, "two lines of argument, based on the same data, have led to diametrically opposite results" (p. 101). This is a somewhat striking phenomenon, and ought of itself to suggest caution in dealing with these problems by numerical methods. In giving his view of the cause of the discrepancy, he fully recognises that his arithmetical argument is entirely competent to prove the advantage, to both sides, of any Müllerian combination *once effected*; though he holds that it does not succeed in accounting for the *process of formation* of such an assemblage, except in the case of considerable disparity of numbers. But when the process is complete, his difficulty ceases.

How is it then that he finds in the formation of a Müllerian assemblage a stumbling-block of this kind? The reason is that he is himself labouring under the error of which he accuses his opponents, viz., that in the representation of the case the intermediate stages are not adequately taken into account. The truth of the matter is that so soon as the aposeme of species B occurs in any of the individuals of species A, the Müllerian association B + A′ is already formed, and A′ enjoys its advantage. On Mr. Marshall's own showing, A′ now virtually belongs to B, which class is strengthened by its accession; and whatever may be A″s chances of survival as compared with typical A, it has at any rate found a place in an assemblage which has so far been able to maintain itself. If its new character is of such a kind as to be subject to Mendelian laws of inheritance, there is no reason why it should not persist under the shelter of B, even in the absence of reinforcement from its original stock.

But a much more important consideration than the above is the fact that the first appearance of aposeme B is consistent with the persistence of aposeme A; a fact which is constantly overlooked, though it is really implicit in the statement that the Darwinian idea of the evolution of a case of mimicry (which is that accepted by Mr. Marshall) "involves the assumption that it has been built up

by a gradual process of selection from comparatively small individual variations" (p. 101). The intermediate form with its double aposeme at once brings the Müllerian factor to bear throughout the whole assemblage which it unites. It is not always realised how easily the gap between A and B may be bridged over. Take the case of *Pieris demophile* (both sexes) and *Acria agna*, a Pierine and an Ithomiine from Brazil. All that is necessary is to insert the yellow form of *P. demophile* ♀ between the normal types of the two species, and the chain is complete from end to end; moreover, it becomes linked on to the great assemblage of which *A. agna* is a representative. I do not assert that this particular association is Müllerian; I only adduce it to show how easily a Müllerian couple might be established. It illustrates some other points as well, viz. (1) that the rise of a mimetic variation does not necessarily involve the extinction of the parent form (this survives in typical *P. demophile*), and (2) that distasteful intermediates may be conceived of as mutually protecting and being protected by the distasteful forms not on one side only, but on each side of them. This last point is of course only another way of putting what I have already spoken of as the function of the double aposeme. It is obviously of the first importance for the right understanding of Müllerian mimicry.

It may be said, in reference to the foregoing, that I have taken a case where mimic and model are already somewhat alike. Let me therefore now show how the two hypothetical species A and B may be brought into association with one another, though originally very dissimilar in aspect. If we were to confine ourselves to theory, I admit that the process might be somewhat difficult of conception. But when we turn to the actual facts of such a case, we see how the passage may be helped along by the existence of other species, each of which is capable of forming a collateral association with the transitional forms in turn. Thus, a very slight modification of the yellow form of *P. demophile* ♀ gives us another Pierine form, that of *P. viardi* ♀, which aligns itself with *Heliconius charithonia*; while a short step onwards from *P. viardi* brings us to the form now called *P. tithoreides* ♀, the mimetic relation of which with *Tithorea pavonii*, *H. atthis*, and the *peruviana* form of *H. charithonia* will only be questioned by those who do not accept the doctrine of mimicry at all.

There is no need to multiply instances, though it could readily be done. The point required is to recognise the fact that a mimetic chain can be built up by successive small steps, each of which secures at once the condition which Mr. Marshall himself maintains is favourable to the Müllerian relation; for he allows, as we have seen, that when the association is once formed, the advantage to all parties, whatever the relative numbers, can be demonstrated by arithmetic.

This first concession, when followed out into its consequences, appears to me of itself sufficient to dispose of the only serious objection brought on *a priori* grounds against the possibility of Müllerian approach, whether from one side or from both, even in those cases where both species may be equally "dominant." But if this were not so, Mr. Marshall's second concession (p. 103) would really give me all I want, for by it he asserts the possibility of the very interchange that I have all along been holding in view. I am not disposed to raise a controversy about the mere use of words, and if Mr. Marshall prefers his own term "Alternate Mimicry," I have no objection to offer; the point is that he allows the same possibility that I maintain; the occurrence, that is, of a give-and-take process between so-called "mimic" and "model." This is the essence of what has been called Reciprocal Mimicry or Diaposematism, for which terms I could suggest no more suitable definition than "the interchange of characters between distasteful forms in virtue of their distastefulness." No one could suppose that every step from the one side is exactly in point of time coincident with a step from the other; nature works on successive individuals, and whether or not at any given moment the general trend is in one direction rather than another is immaterial. Moreover, it is conceivable, even on Mr. Marshall's principle, that the tendency might take opposite directions at the same time in different parts of the area of distribution.

Particular Instances of Diaposematism.

So much for the attempts that have been made to impose limitations *a priori* on the scope of Müllerian mimicry, and in especial to disallow the possibility of that interchange of features between distasteful forms which is known as Diaposematism or Reciprocal Mimicry. I now turn to the particular criticisms which Mr. Marshall makes on the

diaposematic interpretation of certain concrete and definite instances.

With regard to these instances, I would in the first place observe that they are not all of equal strength, and that, as I have always been ready to admit, there is perhaps not one of them that is absolutely incapable of being explained on other lines. But their force, as it seems to me, lies in their cumulative effect. Let me give an illustration. Suppose that on a riding or driving tour through the country, you see, on approaching a town, a boy wearing a straw hat with a variegated ribbon. By and by you meet with another boy, then with two or three more, finally perhaps with a little crowd of boys, all with the same coloured hat-ribbon. The first occurrence makes no special impression on you, nor perhaps the second or third, but before long you awake to the fact that there must be some common cause for this constantly recurring phenomenon, which cause will probably declare itself as the existence of a school or an athletic club. So with these instances of apparent interchange. Taken separately, each one may be put down to accident, coincidence, affinity, or what you will; but as cases begin to accumulate, any explanation short of the influence of some common law or principle ceases to be satisfactory. With respect to Mr. Marshall's remark that no example of Diaposematism has as yet been brought forward as occurring between any two of certain groups that he specifies, it may be sufficient to observe that these groups, so far as I am aware, have never yet been studied from this particular point of view.*

The Association of Pereute *and* Heliconius.

Under this head I am pleased to find that Mr. Marshall at least agrees with me that there is a mimetic relation between the *melpomene* group of *Heliconius* and a *Pereute*, though Mr. Kaye would perhaps differ from us both (see his communication in Proc. Ent. Soc. Lond., 1908, pp. xxii, xxiii). But Mr. Marshall, in commenting on my suggestion that the *Heliconii* which enter into mimetic combination with Pierines have been influenced by the latter "in adopting from them a more distinct and characteristic employment of the red basal patches," remarks that "in order

* See however Fritz Müller (translation by Meldola in Proc. Ent. Soc. Lond., 1879, p. xxviii), who actually alleges cases, though without giving details.

that any case of this kind may really carry conviction as a proof of diaposematism it is necessary to show that the reciprocal character which the model is claimed to have acquired from the mimic must be one that is abnormal in the genus of the model and its allies." On this I would observe that if Mr. Marshall will look again at my paper from which he quotes (Trans. Ent. Soc. Lond., 1894, pp. 296–298), he will see that I do not claim that the existence of the red basal patches in *Heliconius* has been "acquired from the mimic." On the contrary, I am in that passage at pains to show that there already exists in *Heliconius* material in the shape of red basal markings for the aposeme that becomes especially conspicuous in those species which enter into mimetic relation with red-spotted Pierines. Hence his enumeration of red-spotted *Heliconii* is beside the mark, for he has not met my assertion that the spots are especially distinct and characteristic in these mimetic species. My view was and is that the Pierines have contributed to the special appearance presented by the spots in certain species; not that they are actually responsible for the origin of those marks. I fear I cannot agree that a character such as this, if reciprocally adopted, must be "abnormal in the genus of the model and its allies," for in most cases there will be found already existing, as might be expected, some basis for the assimilative process to work on.

While the *Heliconii* are under consideration, it may not be amiss to remark on the great plasticity exhibited by this genus, so far as concerns its colour-patterns. This is exemplified by the large number of species which, as Mr. Marshall says, "have been drawn away in mimicry of the great *Melinæa-Mechanitis* association," and still more by the completeness with which members of one of the two great groups into which the genus falls have become assimilated in aspect to species belonging to the other.* Mr. Marshall himself suggests that the absence of red spots in the *Melinæa*-like *Heliconii* may be due to mimicry, which shows that in his view this feature of the Heliconine pattern is not resistent to mimetic influence. As regards the Pierines, there is no reasonable doubt that the red basal aposeme in *Delias* has impressed itself not only upon *Prioneris* but also on Chalcosid moths (see Shelford, Proc.

* See Riffarth and Stichel, in the "Thierreich," 1905; also W. J. Kaye, Proc. Ent. Soc. Lond., 1907, pp. xiv–xvi.

Zool. Soc. Lond., 1902, vol. ii, No. 257, Plate XXI, figs. 1–4). There is, therefore, no antecedent improbability in the supposition that the corresponding aposeme in the South American Pierines under discussion, less marked but still conspicuous, should have been able to exercise an influence upon the *Helieonii*.

In Mr. Marshall's review of the genus *Pereute* (p. 108) I find myself quite unable to follow him. I confess that I do not understand his statement that it is only in his third section "that we find any real mimicry." I should have thought that mimicry if it exists at all must be real. If he only means that some species are closer mimics than others, of course I agree with him, but the remark in this connection hardly seems worth making. As to the main point, I do not think that any one who undertakes a thorough examination of the genus in relation with other butterflies of the Neotropical region can avoid coming to the conclusion that every species of *Pereute*, even including *P. telthusa*, displays mimetic features. Mr. Marshall's South African experience will suggest to him that to make the examination complete, the under-sides must be included in the study; as indeed in one place he seems to imply.

The under-side red spots in Archonias (*or* Euterpe) tereas *and* Papilio zacynthus.

Under this heading Mr. Marshall has—I am sure unintentionally—given so complete a misrepresentation of my published statements, that I can only suppose him to have omitted to make himself fully acquainted with them. It would, I think, be inferred by any reader of his criticism that I had advanced the view that the *Papilios* belonging to the colour-group of which *P. zacynthus* may be taken as an example had adopted their under-side red spots in mimicry of the associated Pierines (pp. 109, 110). How far such a supposition is removed from my real opinion will be made sufficiently clear by an extract from the very paper that Mr. Marshall quotes as his authority, viz. my memoir on the Pierinæ published in our Transactions for 1894. In a note on page 285 of that memoir occurs the following passage dealing with the butterflies in question:—"The red basal patches on the under-side of the Pierine give just the same general effect as similar patches on the *Papilio*; but a close scrutiny will

reveal the curious fact that the patches of the Pierine belong always to the wing, and those of the *Papilio*, in almost every instance, to the body. The wide distribution of the red basal patches among the *Pierinæ* forbids us to suppose that they were evolved for the purpose of mimicry in these few species; but it is worth noting that their presence affords material ready to hand for a sufficiently deceptive though not absolutely exact copy of a conspicuous Papilionine feature."

It will be seen from the above quotation that the position of the red spots on *Papilio* and Pierine respectively had already been noted and taken into account by me, though this would not be gathered from Mr. Marshall's description on pp. 109, 110. It is also plain that although (like Mr. Marshall) I could not regard the red spots as having come into existence in the Pierine for the sake of mimicking the *Papilio*, I was prepared to entertain the view that so far as position and general appearance were concerned they had undergone Papilionine influence. The fact that many *Papilios*, both mimetic and non-mimetic, are red-spotted, was of course well known to me, and is duly stated in the same paper (Trans. Ent. Soc. Lond., 1894, pp. 296, 298). In these latter passages I suggest the possibility, which still appears to me quite reasonable, that *Papilios*, *Heliconii* and Pierines, all possessing suitable material for working upon, have each, in the case of these mutually mimetic species, contributed something towards the general agreement. The main points in favour of an exercise of Pierine influence, I may repeat, are (1) the prevalence of the basal red throughout the subfamily; (2) the fact that the genera *Euterpe* and *Pereute* are probably closely allied to the distasteful Eastern genus *Delias*; and (3) the fact that some species at any rate of *Euterpe* and *Pereute* are reported by field naturalists to be abundant in individuals. The suggestion that these South American Pierine "mimics" might themselves act in some respects as models was in 1894 so new, and so contrary to received ideas, that I dwelt on the evidence in question with some emphasis. I still think the evidence strong. So far as Mr. Marshall pronounces in favour of an independent origin of red spots in all these three subfamilies, I agree with him; my expressed view has always been the same. If however he really means that no mimetic modification of the spots

has taken place as between these groups, I think that those naturalists who are well acquainted with the species concerned will regard his conclusion as a *reductio ad absurdum*.

Why do both sexes of Archonias (Euterpe) tereas *mimic only the females of* Papilio zacynthus ?

In this section of his paper Mr. Marshall makes the curious statement that "not a single one of the American Pierines has developed any metallic colours" (p. 111). By "metallic colours" he shows in the same passage that he means an iridescence or glow such as may be seen in certain African species of *Teracolus*, for example in *T. regina*, where it exists in a highly-developed condition. Has Mr. Marshall ever looked at *Dismorphia teresa* ? Or at the male of *Meganostoma eurydice*, or of *Colias lesbia* and *C. vautieri* ? Or at a fine male specimen of *Phœbis argante* ? Even in the Pierine genus at present in question, it is by no means rare for a well-preserved example of *Euterpe approximata* or *E. critias* to exhibit a purple gloss on the hind-wing, a gloss which, though comparatively undeveloped, recalls that of many *Papilios*. The fore-wings of *E. antodyca* ♀ and *E. swainsonii* ♀ often show a similar bloom. Then as to African forms, has Mr. Marshall forgotten *Colias electra*, of which he must have seen innumerable specimens ? There can I think be no doubt that there is nothing in the Pierine constitution to prevent the development of "metallic" colouring, should the opportunity and need for such development arise in the history of a species. In reference to F. Müller's statement that although in his experience *Euterpe tereas* was common, and *Papilio nephalion* rare, the latter must be regarded as the model rather than the former, Mr. Marshall seems to be quite alive to the fact that if this case of mimicry is, as he says, "in every way consistent with the interpretation of a simple Müllerian approach," it remains an instance that *primâ facie* requires a good deal of reconciling with his view as to the improbability of Müllerian approach even when the numbers are equal, and much more when the numbers of the "model" are inferior. I myself should of course agree with F. Müller that the Pierine has adopted most of its peculiar aspect in imitation of the *Papilio* ; but I should not consider that

this precludes the female *Papilio* from having been retained by the help of Pierine influence within the limits of the strong combination thus formed. Mr. Marshall's opinion that the female pattern is the older is very likely to be correct; it has always seemed to me the more probable supposition; though, in view of what may be seen in many other groups, I should not venture to exclude altogether the possibility that the female may have dropped some characters once common to both sexes and even gained others under the influence of mimicry or some other form of adaptation. This is why I suggested in 1894 that the female *Papilios* had joined the *Euterpe* combination, whether by "discarding" or [supposing the females to represent the older form] by "not adopting" the brilliant colours of the other sex (Trans. Ent. Soc. Lond., 1894, p. 298). It was pointed out by me many years ago (Trans. Ent. Soc. Lond., 1890, p. 106, note, *à propos* of *Argynnis diana* ♀; and again in Proc. Ent. Soc. Lond., 1894, p. xii, *à propos* of *A. niphe* ♀) that a mimetic resemblance may be attained by the help of the retention of an ancestral character no less than by the development of a new one. Mr. Marshall's point would only tell against my suggestion if this possibility were ignored.

The suggested reciprocal resemblance between Pieris locusta *and* Heliconius cydno galanthus.

Mr. Marshall begins his discussion of this case as follows:—"In Trans. Ent. Soc., 1896, p. 72 (note), Dr. Dixey suggested tentatively that *P. locusta* ♂ was a mimic of *Heliconius melpomene*, so far as the underside of the hind-wing was concerned. In Trans. Ent. Soc., 1897, p. 325, this idea was abandoned, and the very different *H. cydno galanthus* was then definitely proposed as the model" (p. 113). I shall hope for Mr. Marshall's forbearance if I venture to point out that this is scarcely an accurate way of putting it. My words in 1896 were, "The underside of the hind-wing in *P. locusta*, *P. cinerea* [I should now write *Leptophobia cinerea*] *and some others* resembles that of *Heliconius melpomene and other protected species* in giving the general idea of a dark wing-area with yellow costal or precostal streak and basal red spots." I have never "abandoned this idea," which indeed is merely the expression of a simple matter of fact; but in 1897 I gave the general

statement above quoted a more special application by instituting a comparison between the under side of *P. locusta* ♂ and the *cydno* group of *Heliconius*; even then being careful to point out that "the aspect suggested [by *P. locusta* ♂ underside] is rather that of several forms of *Heliconius* in general than that of any one in particular." Why Mr. Marshall should think it necessary to show that the upperside of *P. locusta* ♂ is non-mimetic "and can have no significance during flight" (p. 113) I am at a loss to understand, for I myself expressly stated that "it is only on the underside that the mimetic pattern appears, and here again there can be little doubt that its use has reference only to the resting position." Mr. Marshall appears to disbelieve that any mimetic significance whatever attaches to either surface of the male *P. locusta*. In this opinion I think few impartial observers will follow him.

With regard however to the "fair general resemblance" which he admits to exist between the upperside * of the female of *P. locusta* and the *galanthus* form of *H. cydno*, he arrives at the conclusion "that the most satisfactory interpretation of the present case is that the ♀ *Picris* is a simple Batesian mimic of the *Heliconius*." In support of this position he makes some remarkable statements. "It is only fair to point out," he says, "that when this proposal" [i.e. my suggestion as to the association of *P. locusta* with the *cydno* group] "was made, the true ♀ of *P. locusta* was not known, the ♀ figured by Dr. Dixey belonging really to *P. tithoreides*, Butl." I regret to have to correct Mr. Marshall on a point of fact, but he will find on further enquiry that the female of *P. locusta* was then known and had been described by Felder. I figured the local race (or geographical species) *tithoreides* under the designation of the type form, for the simple reason that there was then no other name by which to call it, its present title not having been bestowed upon it until some time later.† I do not know on what grounds Mr. Marshall pronounces *P. locusta* ♀ to be "evidently a rare insect." Felder's account ‡ implies that the species is common. I can of course readily believe that the male falls a more easy prey to collectors.

* Why not also the underside? Can it be because this would carry a similar conclusion in the case of the male?

† *P. tithoreides* was first described by Butler, Ann. Mag. Nat. Hist., 1898, ii, p. 18.

‡ Reise d. Novara; Rhop., p. 176.

In stating that "the crux of the whole argument lies in the assumption that white colouring is abnormal in *Heliconius* and must therefore be due to Pierine influence" (p. 114), Mr. Marshall is labouring under a similar misapprehension to that which led him to attribute to me the view that the existence of red spots in *Papilio* originated in mimicry of the Pierines. I have shown that my expressed view was the contrary of this, and that I regarded and still regard the original red spots in both groups as affording material for an assimilative process of which there remain in existence many traces. In exactly the same way I look upon the occasional presence of white patches and bands in *Heliconius* as the raw material from which a resemblance to the broad white areas of the usual Pierine aspect has been in certain species manufactured. Any one who has not realised how much like a Pierine a *Heliconius* can be made to look, should compare the *leuce* form of *H. sapho* with the female of the form of *P. locusta* known as *noctipennis*.

The suggested diaposematic resemblance between the two Eastern Pierines Huphina corva *and* Ixias baliensis ♀.

It would, I think, hardly be inferred from Mr. Marshall's account of this example that nearly all the points which he raises had already been taken into account by me and allowed due weight in my paper which he quotes. Thus the difference between the under sides of the *Huphina* and the *Ixias* is in that paper both mentioned and specially figured, while an explanation is offered which is probably valid in several similar cases (Trans. Ent. Soc. Lond., 1906, p. 522). The fact that the dark border of the hind-wing is better defined in the male than in the female *Huphina* is of course perfectly apparent in my figures (*Ibid.*, Pl. XXXI). These show that although in this particular respect the male has the advantage, the female is still on the whole the better mimic. They also show that the "heavy black bar across the cell of the fore-wing" is not "entirely absent" from the male, as Mr. Marshall alleges, but present in the corresponding position to that which it takes in the female, though of course in the former sex it has not reached so high a stage of development.

The facts as to the geographical distribution of the two species were carefully noted by me (*loc. cit.*, p. 523), as

indeed Mr. Marshall acknowledges. He very truly points out that "if we examine such a series of forms as *Huphina phryne*, *nerissa*, *lichenosa* and *corva*, it seems clear that we are dealing with those progressive modifications which are generally comprised under the name of geographical races." It is also quite correct that "heavy black borders are a very common feature in the genus *Huphina* and exist in a majority of species occurring in the Malay Archipelago." Then why should we assume that the line "leads up" from *H. nerissa* through *lichenosa* to *corva*? Is it not equally open to us to suppose that *corva* began in the Malayan region where so many of its congeners find a home, and passed towards the north and west, gradually losing its black border as it came into new geographical surroundings, but retaining that feature so long as it was subject to the mimetic influence of *Ixias*? If this supposition be rejected, there remains the possibility, or even probability, of other distributional changes. These are more important factors in mimicry than has, I think, been generally admitted.* But the elevation of the present facts of distribution, interesting as they are, into a "serious difficulty" in the way of the diaposematic interpretation of this very curious resemblance seems to savour of hypercriticism; as also, especially in view of Mr. Finn's experiments referred to in my paper,† does Mr. Marshall's evident scepticism even as to the mimicry of *Huphina* by *Ixias*. As to Mr. Wallace's "warning" quoted by Mr. Marshall (pp. 120, 121), I am not in much danger of forgetting it, for I know now that I have several times in the past been temporarily misled into attributing to fortuitous resemblance or to mere affinity many undoubted cases of Pierine mimicry.

The fact mentioned by Mr. Marshall that the British Museum specimen of *I. baliensis* ♀ possesses a suffusion of pale orange in the central area of the fore-wing, a point which had also been noted in my paper (*loc. cit.*, p. 523), is especially interesting; as it shows that in this species the mimetic process is not entirely complete.

The last point which seems to call for remark in this

* See Poulton, "Essays on Evolution," 1908, p. 52; and note by Mr. Trimen on recent changes of distribution in African butterflies, *ib. cit.*

† The reference was given by me as "Journ. Asiat. Soc. Bengal," 1895. The year should be 1897.

connection is the difference in character of flight shown by the two genera concerned. It is of course no proof of palatability or the reverse that an insect is active and wary on the wing. Many distasteful species, especially the "dominant" models, possess the characteristically deliberate demeanour first noticed by Bates, but others show resemblances of greater or less degree in this, as in other respects, to the forms that usually occupy central positions in mimetic groups.

Here ends my survey of Mr. Marshall's criticism of particular instances. I feel justified in maintaining, as a result of this examination, that not only has he failed in each single case to prove his point, but that he has also in many particulars been betrayed into actual error.

The remaining examples impugned by Mr. Marshall, together with that portion of the concluding section of his paper which has not been dealt with by me, bear reference to certain views and observations for which I am not personally responsible. I shall not presume to enter the lists in defence of champions so well able to take care of themselves as my friends Prof. Poulton and Mr. Neave; but it may not be out of place to add here a remark with regard to Mr. Marshall's footnote on page 122 of his paper. He there calls attention to some apparent discrepancies in the accounts given by Dr. Longstaff and myself of the scents of certain African butterflies. It is a well-established fact that scents of opposite character may coexist in the same individual (instances are given in my communication quoted by Mr. Marshall from Proc. Ent. Soc. Lond., 1906, pp. ii–vii), and it seems probable that the differences between Dr. Longstaff's records and my own—a very few differences, be it noted, amidst a large body of substantial agreement—may be attributed to a reason of this kind. Certainly my recollection of the strong, disagreeable odour of *Neptis agatha* is vivid to this day.

Before concluding this paper I have a suggestion to offer to students of the Müllerian problem who may still be in an early stage of their investigations. It is that those who wish to avoid a cramped and narrow view of the mimetic problem should refrain from stating and considering it only in terms of "mimetic pairs" or even "mimetic associations." The real unit of study is the aposeme, in its transitions, its modifications and its

combinations. This will lead, amongst other things, to a recognition of the important principle of "secondary mimicry"; a powerful reinforcement of the Müllerian interpretation, which has been omitted from consideration by Mr. Marshall, and on which accordingly I do not enlarge. A final point to be impressed upon those who may be approaching the question for the first time, is the wonderful insight into future developments of his theory shown by Fritz Müller himself. Reference to Prof. Meldola's translation of Müller's truly epoch-making paper in Proc. Ent. Soc. Lond., 1879, pp. xx–xxviii, will show that not only is the main principle most clearly and precisely there stated, but that the author also foreshadows such subsidiary points as relative distastefulness, "alternate mimicry," the unpalatability of Pierine "mimics," and not only the possibility but even the actual existence of diaposematism.

The kind expressions used by Mr. Marshall on the last page of his paper I should wish most cordially to reciprocate. I may go further, for I believe that I owe more benefit to the results of his experience as a field naturalist and skill as an experimenter than he can have derived from any publications of mine. I am not at all fond of controversy in itself, though I admit its value and occasional necessity. But if one has the misfortune to differ from a friend and fellow-worker in the same field, the regret that is unavoidably felt is much mitigated when one meets so courteous and fair-minded an opponent as on the present occasion.

However, Mr. Marshall has now shot his bolt. It has failed; and the upholders of the large and comprehensive principle of Müllerian mimicry, including its corollary of Diaposematism or reciprocal influence, may await with equanimity the delivery of attack from any other quarter.

XXIV. *On some of the principal Mimetic (Müllerian) Combinations of Tropical American Butterflies.* By J. C. Moulton, F.E.S., of Magdalen College, Oxford.

[Read June 3, 1908.]

Plates XXX—XXXIV.

In the year 1896 Mr. W. F. H. Blandford, with the help of the late Mr. Osbert Salvin, F.R.S., selected a series of mimetic combinations of Tropical American butterflies from the Godman-Salvin collection. These he exhibited in the same year at the Royal Society and at the Entomological Society of London (Proc. Ent. Soc. Lond., 1896, p. xxxviii). They were also shown and described by him in the following year, during the discussion which followed Dr. F. A. Dixey's paper on "Mimetic Attraction" (Proc. 1897, pp. xx–xxxii and xxxiv–xlvii; Trans. 1897, pp. 317–331). The opinion was strongly expressed at the time that it would be of great advantage if the associations could be kept intact, or at least some permanent record of them preserved. As regards the great majority of specimens exhibited by Mr. Blandford this was found to be impracticable; but Professor Poulton, F.R.S., at once began to collect material for similar groups—from the Hope Collection, from the great series of duplicates presented to the Hope Department by Dr. F. Ducane Godman and Mr. O. Salvin, and from other sources. By 1901 so much progress had been made that he applied to Dr. Godman for his kind help in lending the comparatively few rare species which did not exist in the Hope Department. These were added to the Oxford material, and beautiful photographs of four South American combinations (Plates XXX–XXXIII) were taken by Mr. Alfred Robinson of the Oxford University Museum. In order to give some conception of the analogy between Müllerian resemblances in the Old World and the New, a group of Oriental *Euplœinæ* with one convergent Danaine was photographed at the same time (Plate XXXIV). The South American associations, of which a permanent record was thus made, are

as follows, tabulated according to their geographical distribution:—

1. North-Central America (Guatemala, Honduras, and Nicaragua); shown on Plate XXX.
2. East Brazil; shown on Plate XXXI.
3. Upper Amazons (Ega); shown on Plate XXXII.
4. Ecuador, Peru, and Bolivia; shown on Plate XXXIII.

The half-tone blocks for these plates were prepared shortly afterwards by Messrs. André and Sleigh; but in the press of other work Professor Poulton has been unable to publish an account of the material or to describe the plates. Early in the present year he invited me to undertake this task, which I need hardly state has proved an extreme pleasure, in view of the exceptional interest of these mimetic associations. I would here like to take this opportunity of recording my sincere gratitude to him, first, for allowing me the privilege of writing this paper, and secondly, for all the kind help and trouble he has shown in assisting me to produce it. The difficulties of a first entomological paper, so alarming to the beginner, have all been made easy by his kindly surveillance. The following associations, although arranged in a different order, are reproduced with but little change from Mr. Blandford's paper (Proc. Ent. Soc. Lond., 1897, pp. xxii–xxvii): it will be noted, however, that while his combinations were wholly composed of butterflies, certain examples of Heterocerous mimics, as well as a few additional Rhopalocera, have been incorporated in the tables of the present paper. Mr. Blandford spoke of these mimetic associations as "groups," but I have adopted Professor Poulton's suggestion that they should be called "associations" or "combinations."*

In the tabular form in which the associations are set forth below, the Ithomiine models are shown on the left and their mimics on the right; the whole series forming a large combination with a single type of pattern.

* "Essays on Evolution," 1908, Essay X, p. 293:—"In this essay the word 'group' is employed to express an arrangement based on affinity, the word 'combination' or 'association' to express an arrangement founded on bionomic relationship. Thus a genus or family is spoken of as a group, a set of Müllerian models and mimics as an association or combination."

COMBINATION I. (Shown on Plate XXX.)

North Central American Type—Guatemala, Honduras and Nicaragua.

ITHOMIINÆ.

Tithorea sp.
Melinæa imitata, Bates (Figs. 1 and 2).
Mechanitis doryssus, Bates (Figs. 3 and 4).
Mechanitis lycidice, Bates
Ceratinia dionæa, Hew. (Figs. 5 and 6).
Ceratinia fenestella, Hew. (Figs. 7 and 8).

DANAINÆ.

Lycorea atergatis, Doubl. and Hew. (Figs. 13 and 14).

NYMPHALINÆ.

Protogonius cecrops, Doubl. and Hew. (Figs. 21 and 22).
Eresia philyra, Hew. (Figs. 19 and 20).

HELICONINÆ.

Heliconius telchinia, Doubl. and Hew. (Figs. 9 and 10).
Eucides zorcaon, Reak. (Figs. 11 and 12).

PIERINÆ.

Dismorphia praxinœ, Doubl. (Figs. 17 and 18).
Perrhybris (Mylothris) malenka, Hew. (Figs. 15 and 16).

HYPSIDÆ (Moth).

Pericopis angulosa, Walk.

The only addition to Mr. Blandford's list, except the Pericopid moth, is *Mechanitis lycidice*, Bates, which this authority places in an intermediate position between the above North Central-American and a South Central-American (Costa Rica to Panama) combination. He includes four other species in this intermediate position, but these are so much nearer to the southern combination that no mention of them is necessary here. *M. lycidice*, however, is extremely variable, and, in Guatemalan specimens, the black bar of the hind-wing is as a rule well developed, as in the northern Müllerian association. On the other hand, the absence of this feature in many Costa Rican examples permits their introduction into the southern combination.

It will be seen from the accompanying Plate XXX that the general pattern of this association consists of a conspicuous light brown (fulvous) ground colour, crossed by parallel black bands and oblique bars, the apex of the fore-wing being relieved by two yellow bars between the last-mentioned black markings. While it is apparent that all the members of this association have gradually become drawn together into one general pattern, we can also clearly see how single constituent species have followed others in minor characteristics. A specially remarkable illustration of this is afforded by the strong resemblance between *Melinæa imitata* (Figs. 1 and 2) and *Heliconius telchinia* (Figs. 9 and 10). Here, the broken yellow sub-apical bands of the *Melinæa* are closely followed by those of the *Heliconius*. On the under side of the fore-wing, an irregular series of white spots appears along the hind margin of the *Melinæa*, and similar spots are present although very faintly developed and more marginally placed along the anal portion of the hind margin in the *Heliconius*. The same likeness is found along the hind margin of the hind-wing, where however the usual radiating white streaks of the *Heliconius* are shortened into a rough resemblance to the rounded or oval spots of the *Melinæa*.*

The exceptionally close resemblance between two such widely different genera as *Melinæa* and *Heliconius*, as exemplified by *M. imitata* and *H. telchinia*, affords a good instance of the entire independence of affinity and mimicry, as Professor Poulton points out in "Essays on Evolution," 1908, p. 235. Thus two Ithomiine genera (*Mechanitis* and *Ceratinia*), with four different species (including *M. lycidice*), bear a general likeness to the *Melinæa* pattern, and yet none of them afford nearly so close a resemblance as that exhibited by the *Heliconius*. Hence the Ithomiine genus *Melinæa* is far more closely resembled by its Heliconine mimic belonging to a very different sub-family, than by any Ithomiine which contributes a member to the association. Similarly the *Heliconius* bears a much closer likeness to the Ithomiine model than to the nearly allied *Eucides*.

My attention was directed by Professor Poulton to the fact that the second Heliconine of this association, *Eucides zorcaon* (Figs. 11 and 12), also presents in one special detail a resemblance to the Danaine, *Lycorea atergatis*

* See Poulton, "Essays on Evolution," 1908, p. 350.

(Figs. 13 and 14), in this respect its probable model. I refer to the peculiar ochreous colouring of the oblique markings in the fore-wing apical region,—markings which are of a bright yellow tint in nearly all the other constituents of the combination. It should be noted, however, that ochreous markings in this region are characteristic of many species of both *Eueides* and *Lycorea*. As regards their form, the pale markings of the fore-wing present certain similarities in these two species. An irregular somewhat hour-glass-shaped spot appears at the end of the cell of each species, as also an elongate spot with a median constriction near the anal angle. The form of these and the other markings is very variable, but their general likeness is noticeable. It will be found in other combinations considered in the later pages of this paper that the species of *Protogonius* are generally specially associated with those of *Lycorea*. Thus in the present instance *P. cecrops* (Fig. 21) not only possesses the ochreous markings towards the apex of the fore-wing, but the marginal hind-wing spots are more strongly developed on the upper surface than in any other species of the association except *Lycorea atergatis*.

Ochreous bars also appear in the female of the Nymphaline, *Eresia philyra* (Fig. 20), which in other respects has evidently been drawn after *Ceratinia dionæa* (Fig. 6), with its row of distinct yellow spots along the hind margin of the fore-wing. Interesting features of the male *Eresia* (Fig. 19) are the narrow hooked fore-wing, and the absence of special paleness in the apical markings, both suggesting the influence of some *Dione* or *Eueides* (perhaps *E. aliphera*, Godt.).

Dismorphia praxinœ (Figs. 17 and 18) presents several points of interest. First, the size and general shape suggest *Mechanitis doryssus* (Figs. 3 and 4) as the model, as was pointed out by Godman and Salvin :—"The female has a colour resemblance to *Mechanitis doryssus*, a species abundant throughout the same area" ("Biologia Centrali-Americana, Rhopalocera," 1887–1901, Vol. II, p. 176). On the other hand, the yellow apical markings follow far more closely those of *Melinæa imitata* (Figs. 1 and 2), and its mimic, *Heliconius telchinia* (Figs. 9 and 10), especially the latter. The dark bands of both wings correspond more nearly with those of the *Heliconius* than with the narrower markings of the *Mechanitis*.

The *Perrhybris* (Figs. 15 and 16) can only be regarded

as an outlying member of the association; for the male (Fig. 15) does not mimic at all on the upper surface, while the female (Fig. 16) is rather a rough mimic, the wings being comparatively broad and the dark median band of the hind-wing but feebly developed. The mimicry of the under surface of the male *Perrhybris* is discussed by Dr. F. A. Dixey in Trans. Ent. Soc. Lond., 1894, pp. 286 and 320; 1896, pp. 67–72. It is characteristic of this genus, that while invariably entering a Müllerian association, it never presents more than a rough mimetic resemblance. The peculiar serration of the inner border of the deep black hind-wing margin in the female is discussed on p. 594.

The moth (*Pericopis*) is also but a rough mimic; for in it no black median band crosses the hind-wing, although the marginal border is of much greater breadth, and thus the unbroken discal space of ground colour is barely noticeable.

Evidence that members of this association frequent the same locality and may be mistaken for one another by the captor, exists in the Hope Department, where one *Melinæa imitata*, two *Heliconius telchinia*, and an example of the moth, *Pericopis angulosa*, all taken in Honduras in 1895, had been put together as a single species!

A general survey of the association shows that the closest resemblance exists between *Melinæa imitata* and *Heliconius telchinia*. A second pair—although not nearly so close—is provided by *Lycorea atergatis* and *Eucides zorcaon*; a third by *Ceratinia dionæa* and *Eresia philyra*, ♀. Lastly, *Dismorphia praxinoe* ♀ presents a general resemblance to *Mechanitis doryssus*, *Melinæa imitata* and *Heliconius telchinia*. The *Perrhybris* and moth are, as previously stated, only rough mimics of the same pattern.

Combination I. a.

The Guiana Type. British, Dutch and French Guiana.

A detailed account of this association is unnecessary; for it has been described in much detail and illustrated with many beautiful plates by Mr. W. J. Kaye, F.E.S. (Trans. Ent. Soc. Lond., 1906, p. 413). A Nymphaline member, *Eresia eunice*, Hübn., was however accidentally omitted by this naturalist, who has now kindly provided me with the following interesting note on it:—"Up till the date of my paper, October 1906 (Trans. Ent. Soc. Lond., 1906, p. 413), I had received about twenty-five specimens of this species. None of the specimens show

any tendency to melanic hind-wings, but the females are certainly more heavily barred than the males. The latter show a strong tendency to a breaking up of the bar into a series of spots much as in the male of *Eucides nigrofulva*, Kaye, *vide* Pl. XXIII, fig. 13. I do not expect that *Eresia cunice* usually sits with *the Melinæas*, etc., on the white flowers of *Eupatorium macrophyllum*, because I have stopped Roberts sending collections from off these flowers, but still I get a fair number of *E. cunice*. There is not the slightest doubt however that it is a member of the group and derives its colouring therefrom."

Combination II.

The East Brazilian Type.

This type is split up by Blandford into two sub-divisions, (*a*) with *yellow* apical spot or spots in fore-wing. (*b*) With *white* markings in the same position. The following table shows the constituent species arranged as in Combination I.

(a) *The apical spots on the fore-wing yellow.*

Ithomiinæ.

Tithorea, sp.
Melinæa ethra, Godt.
Mechanitis nesæa, Hübn.
Napeogenes xanthone, Bates.
Ceratinia laphria, Doubl.

Danainæ.

Lycorea halia, Hübn.

Nymphalinæ.

Eresia esora, Hew.
Eresia, sp.

Heliconinæ.

Heliconius dryalus, Hopff.
Eucides dianasa, Hübn.

Pierinæ.

Dismorphia astynome, Dalm.

(b) *The apical spots on the fore-wing white.* (*Shown on Plate* XXXI.)

Ithomiinæ.

Mechanitis lysimnia, Fabr. (Figs. 1 and 2).
Napeogenes curyanassa, Feld. (Figs. 5 and 6).
Ceratinia daeta, Boisd. (Figs. 3 and 4).

Nymphalinæ.

Protogonius drurii, Butl. (Figs. 10 and 11).

Heliconinæ.

Heliconius narcæa, Godt. (Figs. 7 and 8).
Heliconius polychrous, Feld. (Fig. 9).

In sub-division (b) another *Heliconius*, *H. polychrous*, Feld., and a Nymphaline, *Protogonius drurii*, Butl., have now been added to Blandford's list.

The principal characteristics of this association are the presence of a broad yellow band parallel to the costal border of the hind-wing, and an oblique bar crossing the fore-wing and passing from near the centre of the costa towards the hind-margin. This nearly median bar is succeeded by a large apical spot, or group of spots, sometimes yellow [sub-division (a)], and sometimes white [sub-division (b)].

Sub-division (a). In this association the Danaine, *Lycorea halia*, affords a striking resemblance to *Melinæa ethra*, although the hind-margin of the hind-wing has not lost its border of white spots. As noticed in Combination I, the *Lycorea* possesses a buff or ochreous tint in place of the usual bright yellow markings so typical of this association.* It is also noteworthy that the yellow of the *Melinæa* is slightly duller than that of the association generally. *Mechanitis nesæa*, besides being smaller, differs slightly from the *Melinæa* in having two small yellow sub-apical spots in addition to the yellow apical patch; there is also a far smaller development of black markings on the basal side of the yellow in the fore-wing; but in spite of these differences the superficial resemblance is very close.

A very good Pierine mimic, *Dismorphia astynome*, enters this association, having in the female the yellow apical spot just as in *Melinæa ethra*. It has furthermore acquired the typical Ithomiine shape with narrow wings. The yellow bar of the hind-wing is not strongly developed, but sufficiently to bring the species well within the combination. The male also has followed the female into the association; although here the hind-wing band is far less yellow and the ancestral white still prevails in the costal area of the hind-wing as in the male of *D. praxinœ*. As in this latter species, the white patch is almost certainly hidden in flight and at rest. The male lacks the apical spot of the fore-wing, although a slight suggestion of it is indicated by a few yellow scales in that region.

* The hind-wing band is not nearly so bright in the *Lycorea* as in other members of the association. Prof. Poulton has given reasons for the belief that the tint may have been even duller about eighty years ago. See Ann. Mag. Nat. Hist., ser. 7, vol. xiii, 1904, pp. 359, 360.

An interesting point emerges in connection with the ancestral white of Dismorphias of this pattern. Besides the white portion on the upper side of the hind-wing mentioned above, a white patch occupies the inner marginal area of the fore-wing under side. The meaning of this retention of the white on parts of the surface hidden by the overlapping of the wings is very clearly explained and illustrated by Professor Poulton in his paper "Natural Selection the Cause of Mimetic Resemblance and Common Warning Colours," Linn. Soc. Lond., Journ. Zool. vol. xxvi, p. 606, pl. 40. In addition to the white patches, there are other distinct traces of the ancestral white on the under side of both wings. These persistent traces are formed by a few white scales—easily visible to the naked eye—near the hind margin of the hind-wing and especially at the apex of both wings. The general appearance of the under side suggests that it may possess a cryptic significance, which is an argument against the unpalatability of this Pierine.*

Sub-division (b). All the Ithomiines resemble each other except for the fore-wing apical markings (Plate XXXI, figs.1–6). *Heliconius narcæa* (Figs. 7 and 8) perhaps follows *Mechanitis lysimnia* (Figs. 1 and 2) more closely than it does any of the other Ithomiines of this sub-division: its likeness to *Melinæa ethra* of sub-division (a) is far stronger. The *Mechanitis* does not exhibit that tendency towards transparency which is so characteristic of large numbers of the *Ithomiinæ*, and is readily noticeable in the *Ceratinia* (Figs. 3 and 4) and *Napeogenes* (Figs. 5 and 6) belonging to this combination. *Heliconius polychrous* (Fig. 9) must be considered a rough mimic. Its principal defect, which is not very apparent in the figure on Plate XXXI, is the great reduction of the tawny colour and the corresponding increase in the black and yellow markings of both wings. *Protogonius drurii* (Figs. 10 and 11) again is a poor mimic, as is customary in that genus. It is, as is also usual in the genus *Protogonius*, the only member of its association with an obviously and strongly cryptic under surface. The yellow band across the hind-wing is easily traceable, although neither sharply defined nor bordered by black, as in the models. The white apical spot is distinct, and the white spots in the hind margin of

* See R. Shelford in Poulton's "Essays on Evolution," 1908, pp. 351, 353.

the hind-wing come out in this Nymphaline as in the *Lycorea*. It also follows the *Lycorea* in the more ochreous shade of the yellow markings of the forewing.

With the object of showing more forcibly that these several species do actually occur together in one area, and have in many cases been caught on the same day, I have appended a list of the specimens collected in Brazil, between 1825 and 1830, by W. J. Burchell. It is a striking fact that one should have to go back to a collection eighty years old in order to gain the best available proof that these butterflies are associated together in space and time!

In addition to many members of both sub-divisions, Burchell took a fine series of the Pierine, *Perrhybris* (*Mylothris*) *pyrrha*, Fab. This species has not been included in the list on p. 591, because the apical spot is absent. Like all members of its genus, it is but a rough mimic, and, as regards the upper surface, a mimic only in the female. Just below the apical region, there is visible, near the hind margin of the fore-wing, the apparent incipient separation of a yellow spot from the oblique bar—a separation which is complete on the under surface. On this account the species is placed in the table of Burchell's captures as printed on p. 595, next to the sub-division with yellow apical spots.

H. W. Bates published the following interesting note on the habits of this species in his paper on the "Insect Fauna of the Amazon Valley" (Journal of Entomology, December 1861, pp. 235, 236): "It inhabits the shades of the forest; but the males are found also in open places, and resort to the moist margins of puddles and streams; the females I have never seen except within the forest; they are much rarer than the males, and are coloured in imitation of certain Heliconidæ * found in the same localities. The species has a wide range; it is common at Rio Janeiro and Bahia; specimens from those localities I find do not differ from those taken by myself in the Amazon region."

An interesting feature is noticeable in the hind-wing where the broad black margin is deeply serrated in its

* In the term "Heliconidæ," Bates included the *Ithomiinæ*, the *Lycorœini* (a section of the *Danainæ*) and the *Heliconinæ*. The two former he called "*Danaoid Heliconidæ*," and the third "*Acræoid Heliconidæ*."

LOCALITY.	DATE.	*White apical spots in fore-wing.*						*Yellow apical spots in fore-wing.*			*No apical spots in fore-wing.*
		ITHOMIINÆ.			NYMPHALINÆ.	HELICONINÆ.		ITHOMIINÆ.	DANAINÆ.	PIERINÆ.	PIERINÆ.
		Ceratinia euryanassa.	*Ceratinia daeta.*	*Mechanitis lysimnia.*	*Protogonius druri.*	*Heliconius narcæa.*	*Heliconius polychrous.*	*Melinæa ethra.*	*Lycorea halia.*	*Dismorphia astynome.*	*Perrhybris (Mylothris) pyrrha.*
Minas Geraës . .	Oct. 14, 1825	...	...	1 + [1] *	..	...	...	...	...	...	...
,, . .	Oct. 15 ,,	...	2	...	..	...	...	...	...	1	...
,, . .	Oct. 19 ,,	1	...	...	...	[1, Oct. 21]	...	...	...	...	...
,, . .	Oct. 29 ,,	...	...	...	...	1+[1, Oct. 30]	...	...	...	1	...
,, . .	Nov. 4 ,,	...	...	3	..	...	...	...	..	...	...
,, . .	Nov. 7 ,,	...	...	...	...	1	...	...	...	1	...
,, . .	Nov. 10 ,,	1	...	2	...	...	...	...	1	...	...
,, . .	Nov. 12 ,,	...	1	...	...	...	...	...	...	...	...
Rio de Janeiro .	Dec. 6 ,,	...	...	1	...	...	...	...	...	...	1
,, .	Dec. 31 ,,	...	...	...	...	...	...	...	1	...	...
,, .	Jan. 31, 1826	...	...	1	...	...	...	...	...	...	1, Jan. 27
Organ Mountains	Feb. 8 ,,	...	...	...	..	1	...	1	[1]	...	...
,, ,,	Feb. 9 ,,	...	...	1 + [1]	..	...	...	...	...	...	...
,, ,,	Feb. 12 ,,	...	1	1	...	...	...	...	...	...	...
,, ,,	Feb. 16 ,,	...	...	1	...	...	...	...	...	...	...
,, ,,	Feb. 21 ,,	...	1	1	...	...	...	...	...	...	...
River Magé . .	Feb. 28 ,,	...	...	1	...	...	...	...	...	...	...
,,	Mar. 1 ,,	...	...	1	...	...	...	...	1	...	...
Rio de Janeiro .	Mar. 7 ,,	...	...	1	...	2	...	...	...	...	6
,, .	Mar. 9 ,,	...	...	1	...	1 + [1]	...	...	...	...	4
,, .	Mar. 10 ,,	...	...	1	...	...	...	...	1	...	2
,, .	Mar. 13 ,,	...	...	...	...	1	...	...	...	...	1, Mar. 12
,, .	Mar. 15-17 ,,	...	...	...	...	...	...	...	...	...	8 + [1]
,, .	Mar. 19 ,,	...	...	...	...	1	...	...	1	...	1 + [1]
,, .	Mar. 21 ,,	...	...	...	...	1 + [1]	...	...	...	...	...
,, .	April 1 ,,	...	...	...	...	[1]	...	...	1	...	3
Santos	Sept. 15 ,,	...	...	1	...	...	...	...	...	...	...
,, ...	Sept. 26 ,,	9 + [2]	...	...	...	...	...	...	...	...	...
Cubatão . . .	Dec. 14 ,,	...	...	1	...	...	...	...	...	...	...
,, . . .	Dec. 16 ,,	...	...	1	...	...	...	...	...	...	...
North of R. Pardo	Aug. 29, 1827	...	...	...	...	...	1	...	...	...	...
Lanboso to Brejo	Oct. 2 ,,	...	...	...	1	...	...	...	...	...	...
Goyaz	Oct. 30 ,,	...	...	...	...	...	...	...	1	...	...
,, ...	Dec. 24 ,,	...	...	...	...	...	...	...	1	...	...
,, ...	Mar. 4, 1828	...	...	1	...	...	...	...	...	...	...
Pará	June 16, 1829	...	...	...	...	...	...	...	...	...	...
,, ...	July 29 ,,	...	...	...	...	...	...	...	...	...	...
,, ...	Dec. 10 ,,	...	...	...	...	1	...	...	...	...	...
	No data.	1	1	...	...	...	...	...	...	...	...
Totals	...	12 + [2]	6	21 + [2]	1	10 + [5]	1	1	8 + [1]	3	27 + [2]

Numbers in square brackets denote the existence of specimens which cannot now be traced. Their data are contained in a list prepared under the direction of the late Professor Westwood.

* Two specimens with this date are recorded in Burchell's note-book as well as in Westwood's list.

costal region, resulting from invasions of the orange-brown ground colour. This suggests the possible transition from a special warning character or aposeme acquired by the *Perrhybris* on the way from the ancestral Pierine white towards this tawny and yellow, black-barred association. Slight traces of this same feature are visible in the *Dismorphia* of this association; and the character is strongly marked in the female of *Perrhybris malenka* of the Guatemala-Nicaragua Combination (see Plate XXX, fig. 16).

The most perfect resemblance between any two species in the above table (in spite of the differently-coloured apical spots) is that between *Melinæa ethra* and *Heliconius narcæa*: the likeness is exceptionally strong. Mention has been made already on p. 589 of the occurrence of a marginal row of white spots in both *Protogonius* and *Lycorea*, and of the further indication of resemblance seen in the buff-ochreous fore-wing markings which in these two species replace the usual striking yellow. In spite of the apical patch of *P. drurii* being white (while that of *L. halia* is ochreous) it seems probable that the *Lycorea* is the chief model of the Nymphaline.

The chief characteristic feature of this association—the yellow hind-wing band—appears independently in *Mechanitis lycidice* of Guatemala, which has already been shown to enter two of the Central American combinations (see p. 587). Many specimens of a fine series in the Hope Collection possess this yellow band in a well-developed condition. In other numerous specimens it is marked to a lesser degree, while in others again it is entirely absent, as we should expect in a member of the more northern combinations.

We now pass from a warning pattern characteristic of the country to the south of the Amazon mouths to a very different type developed beside its upper waters.

Combination III. (Shown on Plate XXXII.)

The Upper Amazons (Ega) Type.

Ithomiinæ.

Tithorea harmonia, Cram.
Melinæa pardalis, Bates (Fig. 3).
Melinæa pardalis, Bates, sub-sp. nov. *madeira* (Fig. 2).
Mechanitis egaënsis, Bates (Figs. 4 and 5.)
Ceratinia fluonia, Hew.

Danainæ.

Lycorea cinnamomea, Weymer (Fig. 1).

Nymphalinæ.

Protogonius castaneus, Butl. (Figs. 10 and 10*a*).

Heliconinæ.

Heliconius pardalinus, Bates (Figs. 8 and 9).

Pierinæ.

Dismorphia egaëna, Bates (Figs. 6 and 7).

The only addition to Blandford's list is a sub-species* of *Melinæa pardalis* from the Rio Madeira to the S.E. of Ega. The principal features of this association are the darkening of the ground colour into a mahogany or chestnut tint, and the mottled appearance of the outer half of the fore-wing, this latter effect produced by broken irregular yellow markings on a dark background. The black markings of the North-Central American type are still visible on the hind-wing, but they are more heavily developed and often tend to fuse together, as in the Guiana Combination. As usual, the *Melinæa* and *Heliconius* stand out as the central pair, *H. pardalinus* (Figs. 8 and 9) resembling *M. pardalis*, sub-sp. *madeira* (Fig. 2) in a most remarkable manner; but the whole of the Ithomiines form with the *Heliconius* and the *Dismorphia* (Figs. 6 and 7) a wonderfully close combination. The yellow spot at the anal angle of the fore-wing in the two species of *Melinæa* appears in the *Lycorea* (Fig. 1), while in the *Heliconius* two spots are placed at the apex of the hind-wing. In the natural position of

* A brief description of this form will be found in the Appendix on p. 604.

the wings during flight or at rest with wings expanded, the upper of these two is doubtless concealed and the lower spot then probably represents that on the fore-wing of the *Melinæa*. The male Pierine *Dismorphia egaëna* (Fig. 6) bears a similar spot at the apex of the hind-wing, and probably mimics the *Heliconius* in this respect. The *Protogonius* (Fig. 10), as before, is only a rough although a most unmistakable mimic, and as in the previous associations, the *Lycorea* (Fig. 1) appears to act as its principal model, both species being conspicuous in the combination for their hind-wing marginal spots and for the ochreous markings of the fore-wing.

The transition from this association to the next is probably in part preserved in a separate Peruvian association, in which the mahogany ground colour has been replaced by orange-fulvous ; the black bands of the hind-wing have fused or half-fused, while the apical yellow markings in the fore-wing are much reduced and wanting altogether in some cases. Thus the three following Peruvian species would be considered obvious members of the Ega association except for the substitution of an orange-fulvous ground colour for the Ega mahogany tint. These are *Ceratinia anastasia*, Bates, a Peruvian form of *Melinæa pardalis*, Bates, and *Heliconius floridus*, Weym. All three species possess both yellow apical and black hind-wing markings, which are very similar to those of the species from Ega. A further stage in this transition is suggested by two species of *Melinæa* (*M. phasiana*, Butl., and *M. orestes*, Salvin), and one *Heliconius* (*H. arcuella*, Druce), in all of which the yellow apical markings are wanting. Except for this deficiency they resemble the former trio. *Tithorea cuparina*, Bates, may represent the next step; for in it the apical region is black and free from all traces of the mottled appearance. The black hind-wing, typical of the next association, is not however found in this *Tithorea*, which still retains the black bar placed upon an orange-tawny ground colour.

These interesting transitional forms lead on to the last Neotropical Association considered in this paper.

Combination IV. (Shown on Plate XXXIII.)

The Bolivia, Ecuador and Peru type.

Ithomiinæ.

Melinæa mothone, Hew. (*cydippe*, Salv.)* (Figs. 1 and 2).
Mechanitis deceptus, Butler (*methone*, Salv., nec Hew.) (Figs 4 and 5).
Ceratinia semifulva, Salv.
Napeogenes achæa, Hew.
Hyposcada fallax, Staud. (Fig. 3).

Satyrinæ.

Pedaliodes praxithea, Hew.
Pedaliodes triaria, G. and S.

Nymphalinæ.

Protogonius semifulvus, Butl. (Figs. 14 and 15).
Eresia ithomiola, Salv. (Figs. 12 and 13).
Eresia murena, Staud.

Heliconinæ.

Heliconius aristiona aristiona, Hew. (Figs. 6 and 7).
Eueides acacetes, Hew. (Figs. 8 and 9).

Acræinæ.

Acræa acipha, Hew. (Figs. 10 and 11).

Papilioninæ.

Papilio bachus, Feld. (Figs. 16 and 17).

Hypsidæ (Moth).

Pericopis hydra, Butl. (Figs. 18 and 19).
Castnia pellonia, Druce.

Blandford's list is here increased by *Hyposcada fallax*, the two Satyrines, *Eresia murena*, and the two moths, while *Napeogenes achæa* almost certainly represents his unnamed species of this genus.

In this large and interesting combination the original striped pattern has entirely disappeared, and the warning

* I here follow Butler's interpretation of Hewitson's figure of *Mechanitis mothone* in "Exotic Butterflies," vol. i, Pl. XLVII, fig. 14. Hewitson's type has not been discovered, but the figure appears to represent a male *Melinæa*, and not a female *Mechanitis*. Blandford's list adopts the synonyms.

appearance consists of a very dark ground colour crossed by a broad black-spotted band of orange-tawny, from the centre of the costa to the anal angle of the fore-wing and apex of the hind. Although a very strong general likeness runs through the whole combination, there are also close resemblances between special members, as for instance the large *Heliconius aristiona* (Figs. 6 and 7), which evidently follows *Melinæa mothone* (Figs. 1 and 2). The spots in the oblique band are superficially alike, while in both species there is very little orange-tawny colour at the apex of the hind-wing.

Another special internal association is formed by *Hyposcada fallax* (Fig 3) and *Eresia murena*, probably a southern form of *E. ithomiola*, Salv. Here the spots in the band are only two in number, both faithfully reproduced in *murena*. Again, as regards the orange-tawny area at the apical region of the hind-wing, the Ithomiine is followed by the *Eresia*. *Eresia murena* is not represented on Plate XXXIII; and the two forms of *Eresia ithomiola* ♀ there figured are not such close mimics of *H. fallax*. It will be seen by a glance at figures 12 and 13 on Plate XXXIII that the outer margin of the oblique tawny band becomes pale, due to the appearance of a yellow tint in these two Eresias, which on that account must be specially associated with the *Papilio* (Figs. 16 and 17), and moth (Figs. 18 and 19), considered on p. 601.

The *Protogonius* (Fig. 14) and the *Papilio* (Fig. 16) are rougher in their resemblance, and perhaps tend towards the *Heliconinæ* and especially the *Eucides* (Fig. 8), rather than the *Ithomiinæ* (Figs. 1–5).

An interesting feature of this *Protogonius* is the absence of white spots in the hind margin of the hind-wing. The reason is probably to be found in the absence of a *Lycorea* from this association. These spots may be considered as ancestral in the *Protogonius*—faint traces of them can still be detected even in *P. semifulvus*—and the presence of a similarly-spotted *Lycorea* in the associations tends towards their retention by the Nymphaline. In this combination (IV), however, in the absence of a *Lycorea*, the *Protogonius* loses its marginal spots and enters more closely than usual into the general mimetic association.

Professor Poulton has also pointed out to me that in Bolivian specimens of *Mechanitis deceptus*, small white submarginal spots are retained in the sub-apical region of the

under surface of the fore-wing, while these markings are absent or occasionally just visible in examples of the same species from Peru and Ecuador. Here the ancestral feature, obsolete in more northern localities, is preserved in the south. In some Bolivian specimens these spots extend round the hind margins of both wings.

Other species showing a closer resemblance within the association are seen in the moths, *Pericopis hydra* (Figs. 18 and 19), *Castnia pellonia*, and the *Papilio* (Figs. 16 and 17). In all these, yellow markings appear at the costa of the fore-wing extending more or less completely along the outer margin of the oblique tawny band, and, except in the *Castnia*, yellow spots are developed along the hind margin of the hind-wing. These features are generally wanting from Combination IV, although, as regards the fore-wing, *Eresia ithomiola* ♀ (Figs 12 and 13) approaches the *Papilio* and the moths. The resemblance of the *Castnia* to *Papilio bachus* is much closer than that of the *Pericopis*. The yellow outer border of the orange-tawny oblique band of the fore-wing in the above constituents of Combination IV, as also in the majority of the specimens of *Napcogenes achæa*, is undoubtedly transitional towards Blandford's "7. Central Colombian modification" of "6. Ecuador Type,"—the latter name being applied by him to the association now being considered. From the evolutionary point of view, however, the yellow fore-wing marking of the Central Colombian association is certainly ancestral, and its absence in Ecuador, etc., a comparatively recent modification. The relationship between these two combinations, distinguished by the presence or absence of the yellow margin to the oblique fore-wing band was clearly pointed out by H. W. Bates in the historic memoir on Mimicry (Trans. Linn. Soc., Lond., 1862, vol. xxiii, Pl. III, p. 514):—"Some of the close resemblances amongst the *Heliconidæ* themselves seem to be kept up by their varying in a precisely similar way. There is a very singular instance in three species of three different genera, *Melinæa*, *Mechanitis* and *Heliconius*, which are all in East Peru, orange and black in colour, and in New Granada orange, black and yellow. This seems to be a case of coincident, simple variation; for if three forms are quite alike in colours, it is conceivable that they may vary alike when placed under new conditions by migration. Our *Leptalides* have been shown not to vary precisely like their

models; and therefore the case just quoted does not throw any difficulty in the way of the explanation I have given; but it is a very extraordinary one."

This passage is a good example of the difficulties in which Bates was placed by the mimetic likeness between specially protected groups. Bates' suggested interpretation seems to indicate that the colour resemblances between the *Heliconinæ* and *Ithomiinæ* had obscured in his mind the essential structural differences between these widely separated sub-families. (See Poulton, "Essays on Evolution," 1908, p. 327.)

In each of the four combinations hitherto considered, the *Ithomiinæ*, *Heliconinæ*, and *Nymphalinæ* are all represented. Combination IV alone contains no Pierine or Danaine member. On the other hand, it provides us with an *Acræa*, two *Satyrinæ*, a *Papilio*, and a Castniid moth. No species belonging to any of these groups enter the three other associations.

The possibility of a single warning pattern gradually changing in the passage from one locality to another, *e.g.* from the brilliant striped pattern of the Guatemala-Nicaraguan type to the more sombre colour of the Ecuador, Peru, and Bolivia type, becomes conceivable when we find transitional stages. Thus we may imagine that the North-Central American type is an ancestral dominant warning pattern, and that on proceeding towards the south-east, the conditions gradually began to favour a darker hind-wing, as in the Guianas, and a yellow band and apical fore-wing markings, as in Eastern Brazil. The favourable conditions here referred to include above all *the influence of changes in the patterns of the most dominant and central models* in the combinations. Following these great associations westward, the apparent differences between the Ega Combination (III) and those of the East and North, is found to be consistent with an underlying similarity. Thus we here recognise in the black band of the hind-wing and the yellow apical markings of the fore, the characters of the North-Central American Combination (I). I have already mentioned instances showing possible transitional stages between the Ega type and the still more westerly association in Ecuador, Peru, and Bolivia.

The whole problem, however, can only at present be one of surmise, owing to the enormous amount of work still to be done in these areas, and more especially in the intervening districts; for until far more data have been accumulated than at present, we can only indirectly infer that certain members of the associations are dominant as compared with others; and it is impossible to feel much confidence in the selection of any single pattern as the ancestral type which has given rise to those of adjacent areas. These questions must remain open until further labours have thrown far more light upon this fascinating subject.

Certain Müllerian Combinations among the Danainæ of the Old World.

The accompanying Plate XXXIV exhibits members of three small associations from Southern India, Fiji and the Solomon Islands respectively. The names and localities are indicated on the plate itself, and, in greater detail, in the explanation of plate. The colours and patterns are those characteristic of an important Eastern section of the *Danainæ*—the *Euploëini*. In the two first-named localities, certain species of this section are seen to resemble one another: in the third locality a species (Fig. 10) of the other important section of the *Danainæ*—the *Danaini*—has assumed the superficial appearance of an Euplœine (Fig. 5). It is unnecessary to speak in any detail of the associations represented on Plate XXXIV: they are only introduced on the present occasion for the striking comparison which they afford with the New World Combinations exhibited on the four preceding plates. I may, however, remark upon the interesting example of Fijian mimicry in Figs. 4 and 9. It is here obvious, as Professor Poulton pointed out to me, that the chief spot in the fore-wing of *Deragena proserpina* (Fig. 9) has been lengthened inwards so as to afford a superficial resemblance to the chief spot of its model *Nipara eleutho* (Fig. 4). Although the two chief elements of the pattern in these two Euplœines have thus attained a considerable degree of resemblance, it is certain that they belong to a different series of white markings,—sub-marginal in the mimic (Fig. 9), discal in the model (Fig. 4).

In these Old World Combinations no *Ithomiinæ* lead

the way, and their place is taken by the highly distasteful *Danainæ*, so dominant in the Oriental and Ethiopian Regions. In the former, both *Danaini* and *Euplœini* (here alone shown as models) are dominant; in the latter, the *Danaini*. The examples figured on Plate XXXIV are valuable for comparison with those from the New World; for they prove that, with an entirely different superficial appearance, the same bionomic principles are equally prevalent in the tropics of both hemispheres. The *Danainæ* of the Old World represent and take the place of the *Ithomiinæ* in the New, and exhibit, although with very different colours and patterns, the same conspicuousness at rest and in flight, the same countless swarms of individuals, the same Müllerian resemblances between dominant species, and the same mimetic attraction for less abundant species of other groups.

APPENDIX.

Melinæa pardalis, Bates, n. sub-sp. *madeira*.

Melinæa madeira appears to be a MS. name of Staudinger's. Professor Poulton and Mr. F. A. Heron have very kindly spent much valuable time in an endeavour to trace a description of it, but without success. Thinking that the discrimination of this sub-species of *Melinæa pardalis*, Bates, may be a convenience to naturalists, a description is here added.

Melinæa madeira, n. sub-sp.

This sub-species differs from *M. pardalis*, Bates, in the following points on the upper side. *Fore-wing*: the thick black inner marginal border of *pardalis* (which is limited by the median nervure and first median nervule) is reduced to a narrow, superiorly somewhat diffuse, dark marginal edging in *madeira*. The large triangular black spots, one below the outer part of the cell and the other in the basal part of the cell itself, are reduced by more than half in *madeira*. Exterior to these spots in *madeira* are two yellow oblique angulated bands joined about the second median nervule; in *pardalis*, however, the inner one has become suffused with the mahogany ground colour (with the exception, in one example, of a

single yellow spot just under the sub-costal nervure). In the type of *madeira* (Fig. 2) the apical markings of the fore-wing of *pardalis* are nearly obliterated by a fuscous suffusion, but in another example at Oxford they persist almost as in the Ega form. The yellow spot at the anal angle in *madeira* is well developed, being larger than in *pardalis*. *Hind-wing*: the black bar across the hind-wing so strongly developed in *pardalis* is much reduced in *madeira*, and does not reach the inner margin. All its constituent markings in *madeira* are somewhat rounded and give a less continuous appearance than the compact bar and marginal border of *pardalis*. This latter is also greatly reduced, being much narrower and more completely divided into its constituent markings. On the under side the same points of difference occur as on the upper; although the black markings in the fore-wing of *pardalis* are here not quite so obviously heavier than those of *madeira*. A noticeable difference in the fore-wing is the appearance, along the hind-margin (above the anal spot), in *madeira* of four (in one specimen) small pale-yellow spots which are absent in *pardalis*. In the second specimen the spot nearest the apex is barely distinguishable.

Type ♀ in Hope Department, University Museum, Oxford (Plate XXXII, fig. 2).

Distribution, based on two ♀ specimens in Hope Department, with the general locality Amazons, and one ♂ and two ♀ in the British Museum from Manicoré, on the Rio Madeira, the most important southern tributary of the Amazon.

In another specimen of *M. pardalis*—probably taken higher up the Amazons in Northern Peru or Ecuador—a more chestnut-fulvous ground colour takes the place of the mahogany tint, and the sub-apical markings lose much of their yellow shade. The yellow spot at the anal angle of the fore-wing is still more obscured. The presence of this chestnut-fulvous colouring shows a transition into other Peruvian forms in which this change is carried still further.

H. W. Bates (Trans. Linn. Soc., Lond., 1862, vol. xxiii, part iii, p. 552) makes an interesting note on this very point. He writes: "I did not meet with *M. pardalis* at S. Paulo; but at Tabatinga, eighty miles further west, it again occurred, not however under precisely the same form as at Ega, but in a modified state, the yellow

cross-belt and the spot at the hind angle of the fore-wing having become of the same dark orange-brown hue as the rest of the wing. The same transformation of colour takes place in many species of *Heliconidæ* in travelling from east to west, and I am inclined to think it is due to the direct action of the physical conditions of the localities on the early states of the insects."

M. madeira must be considered a south-eastern form of *M. pardalis*, whose chief habitat is at Ega, on the Upper Amazons.

It should be observed that in this description two ♀ ♀ of *M. madeira* were compared with two ♂ ♂ of *M. pardalis*.

My sincere thanks are due to Mr. R. Trimen, F.R.S., for his kind help in the above description.

Explanation of Plates XXX—XXXIV.

[*See Explanation facing the* Plates.]

XXV. *Bionomic Notes on Butterflies.* By G. B. Longstaff, M.A., M.D., F.E.S.

[Read October 7th, 1908.]

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Introductory.

When travelling in a country new to him it is almost inevitable that an entomologist's time should be chiefly taken up with searching for insects and securing specimens—his temptation is to become "a mere collector." Further, such observations of more scientific value as he finds time to make are but too apt to be isolated, imperfect and inconclusive. Yet something may be done even during a flying visit, and a judicious arrangement of the notes made may provide useful material for further work by the same naturalist, or by a more capable or more fortunately circumstanced observer, following his footsteps.

But it may be objected to such a paper as this, that it is made up of trivial details, that it is loaded with wearisome repetitions, that everybody has long been familiar with the facts brought forward—in short, that it is but a laborious "demonstration of the obvious."* So be it. For the sake of argument these propositions might all be admitted, and yet the time spent in writing the paper, and

* *W. Bateson*, F.R.S., Report of British Association, 1904, p. 577.

even the space occupied by it in the "Transactions" be amply justified.

The immortal work of Lyell, of Darwin and of Wallace was largely built upon seeming trivialities, on facts many of which were "obvious," and therefore to some persons uninteresting. But with what different eyes do we now look upon those same facts, filled as they are with new meaning! Surely present-day naturalists cannot do better than follow humbly in the footsteps of those "old masters" —observe, record and arrange facts—extract and dress the ore ready for some future metallurgist to smelt, so that some future smith may have the wherewithal to forge useful tools or works of art.

Far more experienced observers than the writer have unfortunately lacked the time or the inclination to place their facts on record. Indeed it is one of the saddest things in the history of science that so much knowledge has perished with the gleaners.* Again, though the facts may have been recorded it is surely well that they should be confirmed, even time after time, before hasty inferences are drawn. Yet again, it is surely desirable to find out how far the facts extend, to what species, genera, families; to what degree they are developed; whether they vary in the two sexes, in the individual, the species, the genus; how they are distributed in space and time and season. Lastly, it is just possible that here and there a seemingly small fact, a residual phenomenon of real import, may have hitherto escaped observation, or at any rate may not have been recorded.

With this apology the following somewhat disjointed notes are communicated, notes on observations made for the most part in the West Indies or Ceylon, but some in other lands and some in Devonshire. Previously recorded kindred observations of the author's are referred to in foot-notes, and occasionally quoted in full, with a view to focussing, as it were, all the scattered facts, in the hope of illuminating even to a small degree sundry holes and corners in the great mystery of evolution.

§ 1. *Scents.*

It is now four years since Dr. F. A. Dixey drew atten-

* Col. C. T. Bingham's diaries were in my mind when writing this; he died the week after the paper was read!

tion to the scents of certain common British butterflies.* Since then, dealing with South African material, he has confirmed Fritz Müller's important generalisation,† that these scents may be divided into two classes:—(1) those which are presumably attractive, and are found (with few exceptions) in the male insect only; and (2) those which are presumably repulsive, or protective, and are (with very few exceptions) common to both sexes, often strongest in the female. Further, Dr. Dixey has called attention to the fact that the scents of the first class are agreeable to the average human perception, while those of the second class are for the most part disagreeable, or even disgusting.‡

The additional facts that I am now able to supply appear to confirm previous generalisations, though there are a few apparent exceptions which require further elucidation.

One point may here be mentioned. In addition to the scents hereafter dealt with, a "mousy odour" is in several cases recorded; this is not confined to one sex and is met with in butterflies belonging to various families, but only *after death.* This I believe to be a product of decomposition of either the animal juices or the fæces. The odour resembles that of acetamide, and not improbably may be due to that substance, or some compound ammonia.

It will be noticed that in but very few cases have I concerned myself with the special organs which are involved in elaborating or distributing the scents. Moreover, the subject is now so familiar and the number of species known to produce scents perceptible to man is now so large, that it does not seem necessary to give the new evidence in great detail, nor (as a rule) to deal with species in which positive results have not yet been clearly established.

In the present state of our knowledge it seems most convenient to deal with the various species observed in the order of their systematic arrangement in our cabinets.

* *Dixey*, Proc. Ent. Soc. Lond., 1904, pp. lvi–lx.

† *Fritz Müller*, Trans. Ent. Soc. Lond., 1878, pp. 211–221.

‡ *Dixey*, Proc. Ent. Soc. Lond., 1905, pp. liv–lix; *ibid.* 1906, pp. ii–vii. See also *Wood-Mason* and *De Nicéville*, Journ. Asiatic Soc. Bengal, 1886, vol. xv, Part II, No. 4, pp. 343–393. See also *Longstaff*, Ent. Month. Mag. 1905, pp. 112–115; do. Proc. Ent. Soc. Lond., 1905, pp. xxxv–xxxvi; do. Trans. Ent. Soc. Lond., 1905, pp. 137–8.

So far, however, as the facts are available it would appear that, speaking generally, the *Picrinæ* and *Satyrinæ* belong to the first class, or those with attractive scents, whereas the *Danainæ*, *Acræinæ* and *Heliconiinæ* belong to the second, or those with repulsive scents. The *Ithomiinæ*, *Nymphalinæ*, *Lycænidæ* and *Papilioninæ* contribute to both classes. Of other groups little or nothing is known as regards scents.

NYMPHALIDÆ.

Ithomiinæ.

Tithorea megara, Godt. (Trinidad, 1907). Three ♂ had a very distinct, or even strong, scent, which was compared by both Mrs. Longstaff and myself to Stephanotis, but I thought that it had in addition a spicy, or dusty element. A ♀ was scentless.

Athesis clearista, Dbl. (Venezuela, 1907). A ♂ had a slight sweet flowery scent, both alive and dead: it appeared to be associated with the brushes on the hind-wings.

Leucothyris victorina, Hew., and *L. phemonoë*, Dbl. (Venezuela, 1907). A ♂ of each of these species had an offensive odour, which in the latter case seemed to be associated with the tufts or brushes on the hind-wings.

Danainæ.

Anosia archippus, Fabr. (Jamaica, Tobago, Panama, Venezuela, 1907). 15 ♂, 2 ♀. All had a scent, similar in quality and intensity in both sexes; it is described in my notes as "slight," "moderate," or "strong," and is compared to that of a cockroach, a musk-rat, a rabbit-hutch, or musty dung; in two cases it is qualified as "scarcely unpleasant," and "scarcely disagreeable."

Danaida plexippus, Linn., *genutia*, Cram. (Mátherán, Bombay Presidency, 1908). A ♂ had a slight "musk-rat" odour in the field, none at home though still alive.*

Danaida jamaicensis, Bates (Jamaica, 1907). 2 ♂, 2 ♀. Of the two males the scent is described respectively as "strong rabbit-hutch odour," and "decided odour, ? cockroach, scarcely disagreeable." Of the females it is noted "both with a strong cockroach smell, perceptible next day: my wife, however, described the odour as slightly fusty."

* Compare *Longstaff*, Trans. Ent. Soc. Lond., 1905, p. 138.

Danaida eresimus, Cramer (Colombia, Venezuela, 1907). Of 2 ♂ it is noted "? very slight pleasant scent"; of a ♀ "strong, ? musk-rat odour when alive."

Tirumala septentrionis, Butl. (Ceylon, 1908). 11 ♂ were examined, 9 of them yielded a scent, noted as "slight," "moderate," or "decided," and described as pleasant or sweet, and in two cases compared (with, however, some hesitation) to clover. In four instances the genital tufts were displayed; certainly in one of these no scent was perceptible (though subsequently detected in the house). In another instance it is noted that the scent was not connected with the "sexual pouch" on the hind-wing.

Seven ♀ were examined: in 6 the result was negative or doubtful; in the other a slight scent was found and compared in the field to *Stephanotis*, but Mrs. Longstaff in the house said "? ginger."

This species is exceptional among Danaines,* having a decidedly agreeable scent, strongest in the ♂.

Danaida chrysippus, Linn. (Ceylon, 1908). Of 2 ♂ one was without scent, in the other the "musk-rat odour" was detected both during life and after death. In 2 ♀ the musk-rat odour was detected in the field but noted as especially strong at home.†

Chittira fumata, Butl., *taprobana*, Feld. (Ceylon, 1908). Out of 4 ♂ and 4 ♀ a scent was noted in 2 of the latter only, described in the field as "a slight musty scent," but on re-examination in the hotel compared to stale tobacco-smoke. In 1904 the results obtained were more positive —"it has the 'acetylene' odour of *Crastia core*, but not so strong and with a difference." ‡

Parantica aglea, Cram., *ceylanica*, Feld. (Ceylon, 1908). A distinct scent was detected in 15 ♂ out of 17, and in 11 ♀ out of 14. In the ♂ the scent varied from "very slight" to "strong," twice indeed it was so strong as to be clearly perceptible when the insect was fluttering in the net. In quality it was in 13 cases compared to acetylene (it being specially noted in one instance as "*not Hamamelis*"); in the other 2 specimens it is described as "acetylene *plus* cockroach," but these when re-examined in the house were described as "cockroach only," and

* Compare *Bingham*, "Fauna of British India: Butterflies," vol. i, p. 2.

† Cf. *Dixey*, Proc. Ent. Soc. Lond., 1906, p. iv.

‡ *Longstaff*, Trans. Ent. Soc. Lond., 1905, p. 131.

"slightly musty" respectively. In 6 cases in which there was a decided, or even strong, scent in the field, none was detected in the house; in other instances the scent at home was slighter, or even described as "musty," but in one specimen it was compared to sweet hay.

In all the 11 ♀ the scent is compared to acetylene, with the remark in one case "not so pungent as *Euplœa asela*." Two other ♀ specimens were said to have a musty odour.

I am satisfied that in the case of *P. aglea* the scent is more transitory, possibly more volatile, than in the majority of scent-yielding butterflies.

Crastia asela, Moore (Ceylon, 1908). In 32 out of 38 ♂ and in 17 out of 19 ♀ examined a scent was noted in the field. In 4 ♂ and 1 ♀ my notes record that no scent was detected, as regards the others they are silent. Again, it is clearly recorded that on re-examination in the hotel in the case of 13 ♂ and 5 ♀ no scent could be detected, moreover when a scent *was* noted at home it was in the large majority of cases (especially among males) much fainter than it had been in the field.

In both sexes the scent varied considerably in strength: it was I think quite as strong in the females as in the males, though certainly the three instances in which the scent was strong enough to be obvious through the net were all males. In one ♂ the scent was described as "not unpleasant"; in 5 instances—1 ♂, 4 ♀—it is described as pungent and compared to acetic acid. In the case of a ♀ the note is: "strong pungent odour, acetic acid: distinct at home, still pungent (insect alive). The scent adhered to the fingers after pinching."

As in the case of *Parantica* the scent of *Crastia* would appear to be more volatile than in the *Pierinæ* or in *Limnas*.

Having abundant material I made some endeavour to ascertain the source of the scent. In 15 cases it is noted that the ♂ genital tufts were fully everted when the insect was examined, nevertheless in 5 no scent could be detected, although in the others it was more or less strong. There is a special note in one case: "the acetylene odour seemed to come from the tufts," but, on the other hand, in 4 cases it is noted that the scent appeared to come from the wings, in one of these from their upper surface.

I then tried the effect of rapid dismemberment immediately after pinching :—

(*a*) A ♂ seen on the wing with tufts displayed. It was caught, pinched and the abdomen amputated. The abdomen yielded no scent, but what I may term the *torso* had a slight acetylene scent, which appeared to come from the wings.

(*b*) A ♂ with the tufts displayed; the amputated abdomen yielded no scent, but the wings a moderate "acetylene" scent.

(*c*) A ♂ with the acetylene scent: amputation proved that it was certainly not connected with the abdomen.

(*d*) A ♂ was dismembered: the scent appeared to come from the thorax.

(*e*) A ♀ with pungent odour was dismembered: the scent appeared to originate in the thorax.

(*f*) A ♀ was dismembered: the scent appeared to come from either the thorax or the base of the wings.

From these facts I am forced to the conclusion that in *Crastia* and in *Tirumala* the scent—which moreover is common to both sexes—whatever its source may be, is independent of the genital tufts which form such a conspicuous feature. This conclusion is contrary to my first impression—and certainly contrary to the impressions of such an experienced collector as Commander J. J. Walker, R.N.*

Pademma sinhala, Moore (Ceylon, 1908). Two ♂ were examined with the following results :—

(*a*) Acetylene odour, moderate in the field, slight at home. (*b*) Moderate acetylene scent in the field, none in the house. It was alive; on pinching it again the tufts were protruded and there was a momentary strong acetylene scent. Of course it does not necessarily follow that the scent emanated from the tufts.

Narmada montana, Feld. (Ceylon, 1908). 5 ♂ all had a strong, or at any rate decided, acetylene odour in the field; at home either no scent at all, or at most a faint musty odour. In one case the strong acetylene odour seemed to come from the upper surface of the body or wings, while there was a suspicion of a sweet scent (compared with some hesitation to sassafras) which

* Compare *Wood-Mason,* Journ. Asiat. Soc. Bengal, 1886, pp. 343-393, quoted by *Dr. Dixey,* Proc. Ent. Soc. Lond., 1906, p. vi. See also *Longstaff,* Trans. Ent. Soc. Lond., 1905, pp. 87, 108.

seemed to come from the tufts. A living ♀ yielded an odour of acetic acid, which persisted slightly after death.

SATYRINÆ.

Calisto zangis, Fabr. (Jamaica, 1907). In 10 ♂, nearly all those examined, there was a scent varying from faint to strong, compared to treacle, chocolate, burnt sugar, or caramel, but in one instance described simply as "aromatic." The ♂ of this species has a very conspicuous brand. Ten ♀ were without scent.

Mycalesis mineus, Linn., f. *polydecta*, Cram. (Ceylon, 1908). In 2 ♂ exposure of the pencils of hairs on the hind-wings produced a strong scent, which I compared to burnt sugar, my wife to "coarse brown sugar," or "treacle."

Yphthima ceylonica, Hew. (Ceylon, 1908). In a few ♂ of this abundant species a very slight scent of chocolate was detected.

ELYMNIINÆ.

Elymnias fraterna, Butl., *undularis*, Dru. (Ceylon, 1908). Four ♂ had an odour resembling that of vanilla-scented chocolate: in one case Mrs. Longstaff compared it to "very strong honey, or coarse brown sugar."

NYMPHALINÆ.

Neptis jumba, Moore (Ceylon, 1908). A faint sweet chocolate scent was detected in a male in the house. A somewhat similar scent was suspected in another male and in a female. On the other hand, no scent was recognised in the much commoner *N. varmona*, Moore.*

Victorina stelenes, Linn. (Jamaica, 1907). Five ♂ appeared to have a slight flowery scent, in one instance suggesting chrysanthemum.

Precis iphita, Cram. (Ceylon, 1908). Two ♂ out of several examined yielded a slight treacly odour. I noted a similar scent in *P. elelia*, Cram., in S. Africa in 1905.†

Cynthia asela, Moore (Ceylon, 1908). Five ♂ out of 8 had a peculiar slight sweet scent, compared at the time to sassafras, or to French-polish.

* Compare Dr. Dixey's results with African species of the genus. Proc. Ent. Soc. Lond., 1906, p. v.

† *Ibid.* p. v.

Dione vanillæ, Linn. (Jamaica, 1907). Of 17 ♂ examined 13 exhibited an odour varying from very faint to very strong: in character this was distinctly disagreeable, and I noted it as "unpleasant," "like cow-dung," or "like asses," but more usually as "like a stable." My wife considered it "unpleasant," or "offensive." Mr. Abell thought it "musky." A single ♂ of the nearly allied *D. juno*, Cram. (Venezuela, 1907), had a slight stable-like odour.

Colænis cillene, Cram. (Jamaica, 1907). In 8 ♂ out of 11 examined there was a scent, decided, but in no case strong. Its character was noted as "peculiar," "sweetish," "pleasant," "distinctly aromatic," "resinous," "drug-like," or "medicinal"; it suggested to me at one time or another tar, Canada-balsam and *pure* carbolic acid, but my wife compared it to ginger, or a mixture of ginger with jasmine. It is evident that this scent puzzled me greatly at the time, but subsequent experience with other scents makes me think that sassafras would probably be the best comparison.

HELICONIINÆ.

Heliconius curyades, Riff. (Trinidad, 1907). Two ♂ were examined; one had a peculiar, rather pleasant, smell, the other none. Two ♀ were also examined, one with a doubtful result, the other had a slight odour like that of the species next mentioned, but it was only perceptible during life.

Heliconius hydarus, Hew. (Trinidad, Tobago, Venezuela, 1907). Eleven ♂ were examined: 3 gave a negative result and 1 was doubtful, but the remaining 7 had a scent which varied from "very slight" to "very strong," and was described as "musty," "like acetylene," or "like hazeline" (*Hamamelis virginica*, Witch-hazel). This last comparison, which struck me as very good, is due to Mr. G. H. Sworder of Cocoa Wattie, Tobago, who was quite familiar with the scent of the butterfly. Eight ♀ were examined, only 1 with negative results; in the other 7 the scent varied from slight to strong, and was described as "disagreeable," "like acetylene," or "like hazeline." In the case of 1 ♂ and 1 ♀ the scent was so strong as to be easily discerned when the butterfly was fluttering in the net.

Five of the above butterflies were captured in Trinidad

on 14 April, 1907, and were examined for scent when their enclosing papers were opened at Oxford on May 6th, or three weeks after death. One of them—*H. euryades*, ♀—had no scent; the others—*H. hydarus*, 3 ♂, 1 ♀—had a slight, but quite decided, scent! Yet, curiously enough, in the case of two of these male *hydarus*, I did not find it possible on the day of capture to be sure that they had any perceptible scent. Finally, when a drawer containing all my black and red *Heliconii* was opened on 15 July, or three months after death, the odour, though faint and evanescent, was distinctly perceptible in spite of the presence of naphthalene!

I have since heard from a professional setter that he had often noticed when setting them that *Heliconii* had a peculiar scent.

Heliconius charithonia, Linn. (Jamaica, 1907). With this species the majority of observations gave negative results, nevertheless in 3 ♂ and 2 ♀ a slight pleasant flowery scent was detected. In one example of each sex this was confirmed by my wife, who described the odour as "sweet."

Eucides aliphera, Godt. (Trinidad, 1907). Three ♂ were examined, 2 with a negative result; the third was noted as having "a strong *Dione* scent," *i. e.* an odour like that of a stable, or of asses. Two ♀ were also examined; they both had decided odours described respectively as:—"peculiar scent, ? acetylene; strong when alive," and as "strong *Dione* scent when living; slight flowery scent when dead."

LYCÆNIDÆ.

Cyaniris singalensis, Felder (Ceylon, 1908). Six out of 8 ♂ had a scent of varying intensity, described in all cases as sweet, once as "luscious," and once as "*Freesia*-like."

Nacaduba atrata, Horsf. (Ceylon, 1908). Two ♂ had a sweet flowery scent, confirmed by Mrs. Longstaff, and in one case compared by her to "very, very faint jasmine."

Lampides elpis, Godt. (Ceylon, 1908). Five ♂, all those examined, had a sweet scent, which in one instance was compared (with some hesitation) to clover.

Lampides lacteata, De Nicév. (Ceylon, 1908). Nine ♂ were examined, all had a distinct smell which was compared to vanilla biscuits, or chocolate sweets.

Lampides celeno, Cram. (Ceylon, 1908). A minority of the numerous ♂ examined had a faint sweet scent.

Catochrysops hanno, Stoll. (Jamaica, Trinidad, Tobago, Colombia, Panama, Venezuela, 1907). One ♂ was noted to have a very strong, sweet, *Freesia*-like scent, but most of my specimens of this tiny butterfly appeared to be odourless.

Polyommatus bæticus, Linn. (Ceylon, 1908). About half of the ♂ examined had a slight scent like that of meadow-sweet.

Polyniphe dumenilii, Godt. (Venezuela, 1907). Ten ♂ of this little black-and-white butterfly gave positive results of a surprising character. In the majority of cases the odour was strong, or even very strong; moreover it was disagreeable; and I compared it to horse-urine, but more usually to pig-styes, or, perhaps more correctly, to pigs! At first it seemed scarcely credible that so small a butterfly could smell so strongly. My only ♀ specimen was odourless.

Rapala lazulina, Moore (Ceylon, 1908). Three males yielded a scent like vanilla biscuits.

Theclopsis tephræus, Hübn. (Venezuela, 1907). A strong peculiar, rather disagreeable odour was detected in a ♂ of this species.

Tmolus cambes, Godm. and Salv. (Venezuela, 1907). I noted in a ♂ a "treacly smell"; Mrs. Longstaff compared it to "coarse brown sugar."

Tmolus palegon, Cram. (Venezuela, 1907). A ♂ had an odour of chocolate.

PAPILIONIDÆ.

Pierinæ.

Enantia melite, Clerck (Venezuela, 1907). The only specimen taken, a ♂, had a scent like mignonette.

Terias euterpe, Mén. (Jamaica, 1907). I had ample opportunities of studying this very common Jamaican butterfly. Of 21 ♀ taken not one was scented, but 31 out of 39 ♂ indubitably were. Their odour varied from "very slight" to "strong" (17 specimens); my wife described it on various occasions as "a slight pleasant smell," "strong, like syringa," "a very soft gentle smell, might be jasmine," and "very slight, sweet, jasmine or syringa." Mr. A. P. Ponsonby who walked with me one day suggested "gorse."

To my own judgment the scent resembled rather clove-pink, but was still more like pink bind-weed (*Convolvulus arvensis*, Linn.).

Terias delia, Cram. (Jamaica, Panama, Colombia, Venezuela, 1907), and *T. phiale*, Cram. (Venezuela, 1907). Results conflicting, but in the large majority of cases negative.

Terias albula, Cram. (Trinidad, Tobago, Colombia, Venezuela, 1907). Results uniformly negative.

Terias nise, Cram. (Trinidad, Tobago, Panama, Venezuela, 1907). Out of 8 ♂ taken 5 had a scent, varying from very slight to very strong; it was compared to that of pink bind-weed. A slight scent was detected in a ♀ specimen, this was confirmed by Mrs. Longstaff.

Terias messalina, Fabr. (Jamaica, 1907). In 6 ♂ out of 10 a scent was noted; it is described in my notes as "distinct" or "strong," and compared to pink bind-weed and to spice. It is also noted as "distinct from that of *euterpe*, more dusty, less specific," but another specimen "more spicy than bind-weed."

Terias westwoodii, Boisd. (Jamaica, 1907). Only 3 ♂ were taken, all had a scent, described in one case as "spice odour, not quite the same as *euterpe*."

Terias libythea, Fabr. (Ceylon, 1908). In several ♂ specimens—at least five—a faint scent was detected, which I compared to that of *Convolvulus arvensis*.

Terias hecabe, Linn. (Ceylon, 1908). I failed to detect any scent in this common *Terias* or any of its allied forms.

Catophaga paulina, Cram. (Ceylon, 1908). The results of my 1904 observations * were only in part confirmed. In both years the scent was noted in the ♂ only, in 1904 it was described as "like sweet briar, but sweeter and more luscious," whereas in 1908 it was variously described as "sweet," "very sweet, ?*Freesia*," "flowery," "decided Meadow-sweet," "decided *Stephanotis*," "extremely sweet."

Huphina nerissa, Fabr. (Ceylon, 1908). The results of Indian observations † of 1904 were confirmed, many ♂ yielding a distinct sweet-briar scent.

Pieris calydonia, Boisd. (Venezuela, 1907). Three ♂ of this species—all that I captured—had a distinct flowery

* Trans. Ent. Soc. Lond., 1905, pp. 128, 130.

† *Loc. cit.* pp. 66, 91, 101, 102, 120, 127.

scent, in one case described as "like that of *G. brassicæ*," in another as "somewhat sickly."

Pieris sp.—apparently undescribed—near *sevata*, Feld. (Venezuela, 1907). The only specimen taken, a ♂, had a "faint, sweet, flowery scent."

Leptophobia aripa, Boisd. (Venezuela, 1907). Seven ♂ out of 8 examined, had a distinct or even strong scent, which I compared on various occasions to orange, *Freesia* and mignonette.

Delias eucharis, Drury (Ceylon, 1908). In India during the winter of 1903–4 I observed the scent of this species and compared it to that of *Ganoris rapæ*, or sweet-briar. On that occasion I made sure of the scent in the ♂, and more than suspected its presence in the ♀.*

My more recent experience enables me to speak with greater confidence. Of 18 ♂ examined a scent was detected in 17; in 4 of these the scent was very slight, or indefinable, but in 12 it was strong, or very strong, and compared to that of sweet-briar. Out of 9 ♀ examined in 3 no scent could be detected, but in 6 specimens there was more or less scent, but in no case was it strong; this was described as "sweet," "dusty or musky," and "faint sweet-briar." Mrs. Longstaff said of the last specimen "very slight lemon-verbena; yes, perhaps more like sweet-briar"; but of another specimen she said "it has a little gentle sort of smell, ? ginger, or ? coarse brown sugar."

Daptonoura lycimnia, Cram. (Venezuela, Trinidad, 1907). The 3 ♂ taken all had a strong, sweet, flowery scent, suggesting *Freesia*. Of 3 ♀ one bears the note "rich sweet scent." There is no doubt whatever about the sex of the individual, neither can I suggest by way of explanation that the note really applies to another individual. This is perhaps the most marked of a very few exceptional cases in which a strong agreeable scent has been observed by me in a female Pierine; for some time my own view was that in each such instance I had been deceived—possibly by a neighbouring flower, or by the scent of another butterfly adhering to fingers or forceps. However, in the case of *D. lycimnia* Fritz Müller observed that the ♀ during courting emitted from her genitalia an odour which he described as "rather faint, though quite distinct . . . very different from that emitted by the wings of the male.

* Trans. Ent. Soc. Lond., 1905, pp. 87, 91, 101.

Fritz Müller found the latter "rather faint and often hardly distinguishable."*

Nepheronia ceylanica, Feld. (Ceylon, 1908). The ♂ of this beautiful butterfly has a more or less distinct scent, which I compared to *Freesia*. A ♀ had a similar scent, though slight, which my wife compared to frangipani.

Phœbis agarithe, Boisd. (Tobago, 1907). Of 3 ♂ examined two yielded a scent noted as being "sweet, neither strong nor pleasant."

Callidryas eubule, Linn. (West Indies, Northern coast of S. America, 1907). In no less than 32 out of the 33 ♂ tested a distinct scent was readily perceived, indeed in the great majority of cases it is noted as "strong," twice as "very strong." In quality the scent was agreeable (Mr. Abell termed it "delicious") and was compared to *Stephanotis*, or *Freesia*, but Fritz Müller † termed it musk-like; Miss Murtfeldt "slight violet." ‡ With the 22 ♀ examined the result was very different; in 9 cases it was negative, but in the remaining 13 a scent was detected, which, though usually described as "very slight," or "slight," and never as "strong," was often distinct enough. In quality the scent of the ♀ *eubule* was disagreeable; somewhat sweet, but recalling bad pomade, or rancid butter, or butyric acid (as Dr. Dixey aptly suggested of another butterfly). Fritz Müller described it as "a very strong peculiar odour, in which some volatile acid seemed to predominate."

Catopsilia pomona, Fabr. (Ceylon, 1908). The sweet scent associated with the fringes of the ♂ was confirmed: § this I compared to *Freesia*, or *Stephanotis*. Out of 27 ♀ examined the result was negative in 18, but in the other 9 a slight, usually very slight, sweet scent without other special character was noted.

Catopsilia pyranthe, Linn. (Ceylon, 1908). The number of specimens taken was very much smaller than of *pomona*, but the scent was more easily detected in the ♂, and more decided in the ♀ than in that species.‖ In both

* *Fritz Müller*, Trans. Ent. Soc. Lond., 1878, pp. 217, 218.

† *Loc. cit.* p. 218.

‡ *Scudder*, "Butterflies of the Eastern United States," vol. ii, p. 1047.

§ Trans. Ent. Soc. Lond., 1905, pp. 121, 122.

‖ For previous experience compare Trans. Ent. Soc. Lond., 1905, pp. 101, 109, 118.

sexes the scent was compared to *Stephanotis*, but in the case of one ♂ to *Freesia*, and in one ♀ Mrs. Longstaff thought the odour was "a little bit hair-oily."

Hebomoia australis, Butl. (Ceylon, 1908). Nine ♂, all those examined, had a heavy sweet scent, in most cases strong, in all decided: my wife and I compared it to the flowers of mango, or cinnamon. In 3 ♀ out of 4 there was a similar scent.

Meganostoma cerbera, Feld. (Venezuela, 1907). One out of three ♀ taken is noted as having had "a slight, very sweet scent; ? clover."

Ixias cingalensis, Moore (Ceylon, 1908). The 9 ♂ examined all had a sweet, but only moderately strong scent which reminded me of meadow-scent. Four ♀ were scentless.

Papilioninæ.

Ornithoptera darsius, Gray (Ceylon, 1908). When at Kandy four years previously Mr. W. G. Freedley, junr., told me that the males of this species had a scent like sassafras, but I had no opportunity then of confirming his statement. Every ♂ that I examined during my more recent visit had a scent, some had a strong scent. At first I compared this to cinnamon and to Canada-balsam; to Mrs. Longstaff it suggested rosemary or "rose-scented hair-oil." Later by the kindness of the Apothecaries Company of Colombo I received through the post a sample of the oil of sassafras, so that I made a direct comparison, with the result that the odours of the oil and the butterfly appeared to be almost identical. The ♀ had an odour like musty straw.

Papilio hector, Linn. (Ceylon, 1908). The ♂ has a musty odour.

Papilio aristolochiæ, Fabr. (Ceylon, 1908). Both sexes have an odour like musty hay. In the case of a ♂ specimen there is a note: "decided disagreeable smell: ? like new black net."

Papilio demoleus, Linn., *crithonius*, Cram. (Ceylon, 1908). A smell like fresh straw was detected in one specimen, a ♂, in another (a ♀) there was "a slight peculiar scent in the field: stronger in the house." *

* Compare *Dixey*, Trans. Ent. Soc. Lond., 1906, p. v, as to the scent of the allied *P. demodocus*, Esp.

Papilio polydamas, Linn. (Jamaica, Trinidad, Venezuela, 1907). An odour resembling that of musty hay, or straw, was detected in 2 specimens of each sex. My wife compared the scent to rue.

Papilio eurimedes, Cram. (Venezuela, 1907). A ♂ had a strong musty straw odour.

Papilio æneides, Esp., *gargarus*, Hübn. (Trinidad, 1907). A living ♀ had a smell of musty straw, which persisted after death.

HESPERIIDÆ.

As yet I have never been able to satisfy myself that any of the Skippers are scented. Dr. Dixey, however, once found a very distinct smell of chocolate in a specimen of *Gegenes occulta*, Trim.* It seems probable that some special manipulation may be requisite to elicit scents in this group.

§ 2. *The Coloured Juice exuded by certain Lepidoptera.*

It has long been known that some butterflies, notably *Danainæ* and *Acræinæ*, yield a copious yellow or green juice on pinching, and this has been commonly associated with the known, or suspected, distastefulness of the insects themselves.† A devoted student of entomology, M. Félix Plateau,‡ has tried to get to the root of the matter by eating, or at any rate chewing, *Abraxas grossulariata* and its larva and pupa. Mr. Marshall has also tried many tasting experiments with South African butterflies.§ The results were in both cases inconclusive. Prof. Poulton thinks that this is only what might have been expected, since we have no right to suppose that a given butterfly tastes the same to us as to an insectivorous bird. It might be added that the likes and dislikes of our domesticated mammals differ from our own. I must confess that no enthusiasm has so far availed to bring me to the point of chewing a butterfly. However, in a few cases I have ventured to taste a minute drop of the yellow liquid, with somewhat unsatisfactory results.

Telchinia violæ, Fabr. (India, 1904). "When injured a

* *Dixey*, Trans. Ent. Soc. Lond., 1906, p. ii.
† See *Dixey*, loc. cit. pp. iii, iv, vi, vii.
‡ Mém. de la Soc. Zool. de France, Tome vii, 1894, p. 375, § 7.
§ Trans. Ent. Soc. Lond., 1902, pp. 405–414.

yellow juice exudes; a minute drop of this placed on the tongue tasted somewhat bitter and disagreeable, but the flavour was by no means strong." *

(Ceylon, 1908.) "The yellow juice slightly bitter."

Crastia asela, Moore. In two ♂ the juice was found to be tasteless: in another it had a slight, ? bitter, taste. In 2 ♀ it was noted as "nearly tasteless," "tasteless, or nearly so."

Pademma sinhala, Moore (Ceylon, 1908). The yellowish juice of a ♂ is recorded as "? tasteless."

Isamia midamus, Linn.; *superba*, Herbst (Hong-Kong, 1904). "The yellow juice expressed by pinching has no marked taste."

A yellow juice, similar in appearance, has been noted in certain *Heterocera* believed to be distasteful. I give the instances which have attracted my attention.

Obeidia tigrata, Guén. (Hong-Kong, 1904). A conspicuous day-flying Geometer, allied to our Magpie-moth. Of this my note is: "Has a somewhat slow flight, and on the wing looks like a yellow butterfly; abundant and decidedly gregarious, many flying about one tree in the afternoon. When pinched it exudes a yellow juice having a bitter taste." I do not appear to have examined it for scent, but, whether or no it possesses an evil odour, it has other characteristics of a distasteful species.

Euschema transversa, Walk. (Ceylon, 1908). Of this handsome very slow-flying diurnal Geometer it is noted that it is extremely tenacious of life, but that its yellow juice is tasteless.

Chalcosia venosa, Walk. (Ceylon, 1908). This day-flying moth flutters much about trees (especially *Litsæa zealanica*, N. ab. E.), moving however faster from one tree to another when its flight is somewhat "vapouring." It is tenacious of life, resisting alike pinching and chloroform. It has a peculiar, faint, disagreeable odour, and exudes a yellow juice, the flavour of which still invites investigation.

In contrast to these somewhat ambiguous results is the conspicuous S. African Acridian, *Phymateus leprosus*, Serv.; when touched this emits copiously a dark olive-green very fetid fluid, which when accidentally tasted proved to be both bitter and unpleasant.†

* *Longstaff*, Trans. Ent. Soc. Lond., 1905, p. 103.

† Trans. Ent. Soc. Lond., 1906, p. 335.

§ 3. *The Tenacity of Life of Protected Species.*

That the *Danainæ* and some other butterflies have unusually tough integuments which enable them to resist injuries such as would rapidly prove fatal to the butterfly of ordinary constitution has been long well known.* So far the undoubted fact rests to a great extent upon general statements, but it has occurred to the writer that it may be capable of approximate numerical expression.

With tropical collectors it is a familiar experience that at the close of the day on opening the paper envelopes to examine their captures many of the butterflies are found to be still living. It is an equally general experience that this is especially frequent in the case of the *Danainæ*.

It has for some time past been my practice to enter in my note-book against the data referring to such long-lived individuals "Ten. Vit." (*tenax vitæ*). During my visit to Ceylon in the early months of 1908, I paid closer attention to the matter than previously, and feel confident that in the large majority of cases where a butterfly survived the first pinching the fact was duly recorded. The converse fact, that the insect was found dead in the envelope, was very rarely noted. Under these circumstances it may be fairly assumed that the numbers given below to measure the tenacity of life are, if anything, somewhat understated.

Some one will doubtless lodge the plausible objection that many of the butterflies in the table are large insects and consequently that they should often survive a pinch, such as proved almost uniformly fatal to smaller species, is only what might have been expected. This objection is disposed of by the fact that such a large butterfly as *Cynthia asela*, Moore, was never (13 specimens) found alive in the paper at the end of the day; the same is true of *Cethosia nietneri*, Feld. (9 specimens), and of the robustly made and swift-flying *Hebomoia australis*, Butl. (13 specimens). Again, *Catopsilia pomona*, Fabr., is a fairly robust butterfly, yet out of 49 specimens 3 only, a ♂ and 2 ♀, were noted as "tenacious of life."

From my note-books and previously published papers I find that this resistance to death has forced itself upon my attention in the case of the following species:—

* See e.g. *Poulton*, "Essays on Evolution," 1908, pp. 279, 316. Cf. *Bingham*, loc. cit. p. 2. Also *Marshall*, Trans. Ent. Soc. Lond., 1902, pp. 322-323.

Isamia midamus, Linn. Hong-Kong, 1904. (MS. notes.)

Crastia amymone, Godt.; f. *kinbergi*, Wallgr. Macao, 1904. (MS. notes.)

Danaida chrysippus, Linn. India, 1903. Noted as resistant to cyanide as well as to pinching. (Trans. Ent. Soc. Lond., 1905, p. 98.)

Parnassius hardwickii, Gray. Himalayas,* 1903. "Delicate looking though it be, it is strangely tenacious of life." (*Ibid.* p. 69.)

Telchinia violæ, Fabr. India, 1904. (*Ibid.* p. 103.)

Chittira fumata, Butl. Ceylon, 1904. (*Ibid.* p. 131.)

Acræa cabira, Hopff. S. Africa, 1905. Noted as resistant to chloroform as well as to pinching. (*Ibid.* 1907, p. 328.)†

Anosia archippus, Fabr. Jamaica, 1907. (*Ibid.* 1908, p. 41.)

Danaida jamaicensis, Bates. Jamaica, 1907. (*Ibid.* p. 41.)

Danaida eresimus, Cram. Venezuela, 1907. (MS. notes.)

Heliconius charithonia, Linn. Jamaica, 1907. (*Ibid.* p. 42.)

Heliconius hydarus, Hew. Venezuela, 1907. (Entom. Month. Mag., 1908, p. 118.)

Actinote anteas, Dbl. and H. Venezuela, 1907. (*Ibid.* p. 74.)

An examination of the following list of observations in Ceylon, January to March, 1908, shows, among other things, that whereas $\frac{3}{4}$ of the specimens of *Papilio hector* taken, and $\frac{3}{5}$ of those of *P. aristolochiæ*, are recorded as tenacious of life, this is *not noted of any* of the 9 specimens of *P. polytes*, 5 of *P. mooreanus*, 4 of *P. demoleus*, 3 of *P. teredon*, 7 of *P. crino*, and 14 of *P. agamemnon*.

So far as my observations go there is no difference in the powers of the two sexes of the butterflies here dealt with to resist injuries.

* In the discussion which followed the reading of the paper Dr. Chapman remarked that three or four pinches scarcely availed to kill the common Alpine *Parnassius apollo*, Linn.

† Mr. W. S. Loat, quoted by *Dixey*, Trans. Ent. Soc. Lond., 1903, p. 149, says of *Acræa vinidia*, Hew., on the White Nile, "takes a long time to die when put in the killing-bottle."

	Total specimens taken.	Tenacity of life noted in
Danainæ.		
Parantica aglea, Cram.	31 ...	17
Tirumala septentrionis, Butl. ...	18 ...	9
Pademma sinhala, Moore ...	2 ...	2
Narmada montana, Feld. ...	6 ...	4
Crastia asela, Moore	51 ...	33
„ *core*, Cram. (Mátherán)...	6 ...	4
Chittira fumata, Butl.	8 ...	2
Danaida plexippus, Linn. ...	1 ...	1
„ *chrysippus*, Linn. ...	4 ...	0
Papilioninæ.		
Ornithoptera darsius, Gray ...	9 ...	4
Papilio hector, Linn.	8 ...	6
„ *aristolochiæ*, Fabr. ...	15 ...	9
„ *parinda*, Moore	13 ...	4
„ *lankeswara*, Moore ...	3 ...	1
„ *jason*, Esp.	3 ...	1
„ *teredon*, Feld.	3 ...	0
„ *crino*, Fabr.	7 ...	0
„ *agamemnon*, Linn. ...	14 ...	0
„ *polytes*, Linn.	9 ...	0
„ *mooreanus*, Rothsch. ...	5 ...	0
„ *demoleus*, Esp.	4 ...	0
Acræinæ.		
Telchinia violæ, Fabr.	10 ...	3
Nymphalinæ.		
Hypolimnas bolina, Linn. ...	9 ...	2
Pierinæ.		
Delias eucharis, Dru.	26 ...	3
Catopsilia pomona, Fabr. ...	45 ...	3
Heterocera.		
Chalcosia venosa, Walk.* ...	12 ...	4
Nyctemera nigrovenosa, Moore ...	4 ...	2
Euschema transversa, Walk. ...	2 ...	1

* This species is resistant to chloroform.

§ 4. *Butterflies bearing marks of the attacks of foes.*

This very interesting bionomic point we owe almost entirely to Prof. E. B. Poulton, F.R.S., and Mr. Guy A. K. Marshall.* A list of the butterflies presumably injured by enemies noted by me in India comprised 31 specimens of 28 species.† I append further lists, which amply prove Prof. Poulton's statement that such specimens only want looking for. In nearly every case the injury is symmetrical, *i. e.* affecting the corresponding parts of both right and left wings, so that the probability of the injury being the result of damage during flight by branches or thorns is very small.

Neotropical Butterflies (*West Indies, Venezuela, etc.*), 1907.

Euptychia pharella, Butl. A small symmetrical injury to tips of fore-wings: ? by bird.

Euptychia hesione, Sulz. Symmetrical injury to middle of hind-wings: ? by bird.

Anartia jatrophæ, Linn. A big unilateral injury involving both right wings, noted before capture.

Cystineura dorcas, Fabr. Symmetrical injury to tips of hind-wings.

Didonis biblis, Fabr. ♀. Injury to anal angles of both hind-wings.

Myscelia cyaniris, Hew. Symmetrical injury to hind-wings: ? by bird.

Aganisthos orion, Fabr. Symmetrical injury to hind-wings: ? by lizard.

Colænis cillene, ♂. Nearly symmetrical injury to anal angles of fore-wings.

Colænis cillene, ♂. Symmetrical injury to hind-wings: ? by lizard.

Heliconius charithonia, Linn. ♂. Symmetrical injury to hind-wings.

Thecla togarna, Hew. ♀. Symmetrical injury to hind-wings, involving lobes and tails.

Glutophrissa drusilla, Cram. ♂. Symmetrical injury to both hind-wings: ? by lizard.

* *Poulton*, "Essays on Evolution," 1908, pp. 270, 281–3, 325, as well as the references there given.

† Trans. Ent. Soc. Lond., 1905, p. 134.

Terias delia, Cram. ♀. Symmetrical injury to hind-wings.
Terias messalina, Fab. ♀. Symmetrical injury to hind-wings.

Ceylon, 1908.

Crastia asela, Moore, ♀, nearly all hind margin of right fore-wing and apex of right hind-wing gone.
Crastia core, Cram. (Mátherán, India). Symmetrical injury to hind-wings.
Narmada montana, Feld. ♂. Symmetrical injury to fore-wings.
Yphthima ceylonica, Hew. Small symmetrical injury to fore-wings: ? by bird.
Melanitis leda, Linn. Symmetrical injury to anal angles of fore-wings: ? by bird.
Neptis varmona, Moore. Symmetrical injury to fore-wings: ? by lizard.
Cethosia nietneri, Feld. ♀. Symmetrical injury to middle of hind-wings.
Cethosia nietneri, ♀. Symmetrical injury to tips of fore-wings.
Cynthia asela, Moore, ♀. Large symmetrical injury to hind-wings: ? by lizard.
Cynthia asela, ♂. Symmetrical injury to hind-wings: ? by bird.
Cirrhochroa cognata, Moore, ♀. Symmetrical injury to hind-wings.
Hypolimnas bolina, Linn. ♀. Symmetrical injury to fore-wings: ? by bird.
Hypolimnas bolina, ♂. Symmetrical injury to tips of fore-wings.
Pyrameis cardui, Linn. ♂. Symmetrical injury to hind-wings: ? by lizard.
Lampides celeno, Cram. ♂. Symmetrical injury involving whole hind-margin of hind-wings and an angular piece of fore-wings: ? by lizard.
Delias eucharis, Dru. ♂. Symmetrical injury to hind-wings.
Catopsilia pomona, Fabr. ♂. ? Two symmetrical bites involving both hind-wings.
Catopsilia pomona, ♀. Symmetrical injury to hind-wings: ? by bird.
Catopsilia pomona, ♂. All four wings symmetrically injured by one small bite: ? by bird.

Ornithoptera darsius, Gray, ♀. Long narrow symmetrical injury to hind-wings: ? by bird.

Papilio agamemnon, Linn. Symmetrical injury to hind-wings: ? by lizard.

Algeria, 1905.

Euchloë belia, Linn. ♀. Very sharply cut snip out of each hind-wing, larger on left: ? by bird.

Ganoris brassicæ, Linn. Caught fluttering about flower-bed close to the ground, had been nearly done for by a (?) bird; nearly the whole of both hind-wings and three-fourths of the fore-wings gone.

Hong-Kong, 1904.

Papilio paris, Linn. Almost symmetrical injury to all four wings, large pieces gone.

§ 5. *Experimental Evidence as to the Palatability of Butterflies.*

The following experiments, conducted at the suggestion of Prof. Poulton, are a small contribution to the mass of facts accumulated by Mr. Guy A. K. Marshall and Mr. Frank Finn.*

At our hotel at Kandy were two Mainas (*Gracula*), talking birds of the Starling family (*Sturnidæ*). These birds, which were very tame, were confined in two fairly roomy cages three or four yards apart. I will call the birds A and B.

19 January, 1908. Bird A was given 5 dead butterflies in the following order:—*Atella phalanta*, *Polyommatus bæticus*, *Loxura arcuata*, *Neptis varmona*, *Telchinia violæ*. The bird gave the *Loxura* a few pecks and then let it alone. The tough integument of the *Telchinia* seemed to give the Maina much trouble, but it showed no evidence of disgust. The other three butterflies were taken greedily, the bird, like Oliver Twist, obviously asking for more. It shook the butterflies as a dog shakes a rat.

* *Marshall*, Trans. Ent. Soc. Lond., 1902, pp. 297-397; *Finn*, Journ. Asiat. Soc. Bengal, LXIV, Pt. ii, 1895, p. 344; LXV, Pt. ii, 1896, pp. 42; LXVI, Pt. ii, 1897, pp. 528, 613, 667-8; quoted by *Poulton*, "Essays on Evolution," 1898, pp. 269, 317. See also *Marshall*, Trans. Ent. Soc. Lond., 1908, pp. 137-142.

21 January, 1908. Bird A appeared to be very anxious to be fed. I gave it a dead *Catopsilia pomona*, ♀, which it pecked to pieces: next a dead *Parantica aglea*, it ate its abdomen: then a dead *Papilio aristolochiæ*, after giving this several pecks it left it and did not touch it again. I then gave it two *Crastia asela*, both alive; the fact of life seemed to interest the bird and it tried each of the specimens twice but then appeared to be disgusted and refused even to look at any of the following, of which dead individuals were put into its cage: *Papilio agamemnon*, *Jamides bochus*, a small Lycænid (probably either a *Catochrysops* or a *Nacaduba*), *Loxura arcuata* and *Neptis varmona*.

Same day. Gave bird B a dead *Atella phalanta*, which it ate; after this a living *Crastia asela*, it pecked this several times but did not eat it.

23 January, 1908. Bird A was busy preening its feathers and appeared to have just been fed; I could not attract its attention. While thus engaged bird B sought to attract *my* attention, so I gave it in succession dead specimens of:—*Ergolis* sp., *Telchinia violæ*, *Delias eucharis* and *Papilio aristolochiæ*. It gave the two first a few pecks; the *Delias* it pecked once or twice, but it gave the *Papilio* a single peck only. Perhaps it was not hungry.

I then put the last two butterflies into the cage of bird A. It pecked the *Delias* several times, but the *Papilio* only once or twice. After this it declined even to look at the *Papilio* any more, but came to the front of its cage repeating again and again what sounded extremely like "No good! No good!"

2 February, 1908. Gave Maina A a dead *Nissanga patnia* which it appeared to eat.

4 February, 1908. The Mainas had evidently been fed; there was food in their cages and bird A had upset its food.

Gave A an *Ergolis* sp., which it ate.

Gave B a *Nissanga patnia*; it ate it.

Offered a living *Hypolimnas bolina*, ♂, first to one bird, then to the other; each pecked its wing, but no more.

Bird A would not look at *Cirrhochroa cognata*.

I came to the conclusion that the birds were not hungry, and therefore the observations of little value.

7 February, 1908. Offered to two young chickens first a *Papilio aristolochiæ* and then a *P. polytes*, ♂. One of them looked at the first-named and then walked away; neither looked at the *polytes*.

The same two butterflies were then offered to Maina A, which pecked at both several times, then wiped its beak and left them.

This day's experiments were considered unsatisfactory at the time; it was nearly 6.0 p.m., and perhaps the birds were sleepy.

14 February, 1908. Gave bird A a *Lampides* sp.; it ate it and looked about for more.

15 February, 1908. Gave bird A 2 *Yphthima ceylonica* and 1 *Lampides* sp.; it ate them all three. A *Neptis varmona* was then offered to the same bird, which gave it but one peck. The *Neptis* was then offered to bird B, which also gave it one peck.

16 February, 1908. Gave to bird A three butterflies, *Lampides* sp., another Lycænid (species not noted), and a *Nissanga patnia*: it ate them all up completely. Another specimen of the *Nissanga* was swallowed at the second attempt. An *Ergolis* sp. was also eaten and swallowed. I then offered the same bird a *Papilio aristolochiæ*, this after a peck or two was left. The same specimen was then offered to bird B, which would not touch it. It was then handed back to bird A, which gave it another peck and again left it.

So far as these experiments teach anything, it would appear that these Mainas would eat with relish *Nissanga patnia*, *Yphthima ceylonica*, *Atella phalanta*, *Ergolis* sp., and *Lampides* sp.

On the other hand, *Papilio aristolochiæ* and *Crastia asela* were distinctly distasteful.

The evidence as to the other species experimented with fails to convince me one way or the other.

§ 6. *Mimics in the Field deceiving Man.*

It may not be without interest to record a number of cases in which a collector with defective eyesight has

actually been deceived (at any rate momentarily) by Mimics in the field.*

Benares, 30 November, 1903. When I first captured *Hypolimnas misippus*, ♀, I believed it to be a variety of *Danaida chrysippus*, and I think it probable that other specimens were passed over, as ♂ were very common.†

Anantápúr, February, 1904. This note was made:—"Several times saw the ♂ *H. misippus*, reconnoitring *D. chrysippus*, as if in doubt as to its identity." ‡

Malakand, 29 October, 1903. The ♀ *Argynnis niphe* flying about flowers was noticed to resemble *Danaida genutia*, which was in abundance at the same flowers, though in this case there was no actual deception. §

Konúr, Nilgiris, February, 1904. "On one occasion I watched a ♀ of *Argynnis niphe*, under the impression that it was *Limnas chrysippus*! The resemblance on the wing is greater than might be supposed." ‖

Horton Plains, Ceylon, 23 March, 1904. "*Argynnis niphe* . . . the ♀ on the wing looking very like *Limnas chrysippus*." ¶

Hatton, Ceylon, March, 1908. The following extracts from my note-book point to the striking difference in the general look of the two sexes of *A. niphe* when on the wing:—

"a ♀, captured as *Limnas chrysippus*."

"a ♂, looked like a fritillary."

I would urge strongly that the resemblance of model to mimic may be much closer in the field than in the cabinet.

Báliganj, Calcutta, 5 December, 1903. "The ♀ *Elymnias undularis*, Dru., is a very fair mimic of *Danaida genutia* but its flight is weaker." **

Kandy, 9 February, 1908. A tattered ♀ of *Elymnias fraterna*, Butl., was taken for a tattered *Danaida chrysippus*.

* In addition to the disadvantages inseparable from the loss of the sight of one eye, the writer is both myopic and astigmatic; his astigmatism being only in small part capable of correction by optical means.

† Trans. Ent. Soc. Lond., 1905, p. 84.

‡ *Loc. cit.* p. 109. § *Loc. cit.* p. 74. ‖ *Loc. cit.* p. 113.

¶ *Loc. cit.* p. 132. ** *Loc. cit.* p. 89.

Haragáma, Ceylon, 13 February, 1908. A ♀ *Nepheronia ceylonica*, Feld., on a *Lantana* flower, was taken for *Parantica aglea.*

Durban, S. Africa, August, 1905. *Acræa encedon*, Linn., a somewhat feeble insect with slow flight, was, in spite of its small size, twice momentarily believed to be *D. chrysippus*, which was seen in the same spots on the same days. On the other hand, a small ♀ *D. chrysippus* was actually mistaken for *A. encedon.**

Durban, August, 1905. "Of *Belenois thysa*, Hopff., we took two ♂; when on the wing they were very like the ♂ of *Mylothris agathina*, Cram., in flight and general aspect. Indeed as seen in the net the *Belenois* so closely mimics the *Mylothris* that one of us, though specially on the look out, was completely deceived, and this even when the two insects were taken the same morning." †

Durban, August, 1908. ". . . the curious Geometer *Cartaletis libyssa*, Hopff., of which several were seen, but only one taken. It flies rather high, with feeble fluttering action, and when on the wing somewhat recalls *Limnas chrysippus.*" ‡

Kandy, March, 1904. "Of the tail-less *Papilio lankeswara*, Moore, f. *dissimilis*, Linn. (the pale form), I took three, but probably saw more since it so very closely mimics *Tirumala limniace*, or a large *Parantica ceylonica* (*aglea*), as easily to pass for one of those insects; it is indeed most easily distinguished from them by its habit of fluttering while feeding upon a flower." §

Near Peradeniya, Ceylon, 29 January, 1908. I was with that experienced and keen-eyed entomologist, Mr. E. E. Green, when he netted a *P. lankeswara*, f. *dissimilis*, under the impression that he was catching *Tirumala septentrionis*, Butl.

Kandy, 2 March, 1908. I myself took a ♀ *P. dissimilis* which I imagined to be *Tirumala septentrionis* as it flew past.

Haragáma, Ceylon, 18 February, 1908. Took a ♀ *P. lankeswara*, f. *clytia*, Linn. (the dark form), believing it to

* Trans. Ent. Soc. Lond., 1907, pp. 318, 321, 328.
† *Loc. cit.* p. 325.
‡ *Loc. cit.* p. 327.
§ Trans. Ent. Soc. Lond., 1905, p, 124.

be *Crastia asela*, Moore. This dimorphic mimicry is very remarkable.

Mortehoe, Devon, July, 1902. The first specimen of *Ægeria crabroniformis*, Lewin, that I ever saw alive was at rest on the trunk of a black poplar. Under the idea that it was a hornet I knocked it down and put my foot on it before discovering my mistake.*

Kandy, 21 February, 1908. A specimen of the Clearwing, *Melittia chalciformis*, Fabr., seen hovering over a flower was first thought to be a *Bombylius*, then a Skipper. It distinctly hummed in the net. This instance is quoted to show that the moth, though not suggesting a protected insect, certainly deceived the observer.

Simon's Town, S. Africa, 3 October, 1905. I had much difficulty in distinguishing during life some flies—? *Psoas* sp., and *Prorachthas* sp.—which closely mimicked certain small black, white-ringed Bees, *Halictus albofasciatus*, Smith, ♂, which buried themselves in the flowers of a large *Mesembryanthemum*. In the cabinet the insects look distinct enough, but during life the resemblance, especially in their movements and habits, was very striking.†

Mátherán, W. Ghats, 1908. At the end of March, in a time of extreme drought, insects of various orders were, naturally enough, attracted to such pools as were left about the nearly exhausted springs. Among the visitors were many long-waisted wasps of which I secured a fair number, belonging, as I supposed on a cursory glance, to several species. When Mr. A. H. Hamm had set these for me at Oxford, he remarked, "I see that you have taken a lot of *Conops* along with the wasps that they mimic." Critical examination revealed: HYMENOPTERA:—*Eumenes* ? *arcuatus*, 3; *Eumenes* sp., 1; *Polistes* ? *stigma*, 3; *Icaria* ? *ferruginea*, 1. DIPTERA:—*Ceria eumenoides*, 7; *Conops* sp., 3.

Mortehoe, Devon, August, 1908. Two specimens of the common British Conopid fly, *Physocephala rufipes*, Fabr., suggested to me when alive a *Trochilium* (Clear-wing moth) rather than a wasp.

* Entom. Month. Mag., 1903, p. 196.

† Trans. Ent. Soc. Lond., 1907, p. 380.

Mortehoe, 25 August, 1908. The Syrphid fly, *Chilosia illustrata*, Harr., is common, sometimes abundant, at Mortehoe on the flowers of Ragwort, *Heracleum*, *Angelica*, etc., where it mimics *Bombus sylvarum*, Linn., and the more local *Anthophora furcata*, Panz., sufficiently closely to have deceived for the moment such an experienced hymenopterist as Dr. H. Swale.

Of course we can form but a very imperfect idea of the sense impressions of the lower animals. We know by their actions that hawks see their prey from a considerable distance. The phenomena of mimicry compel the inference that insectivorous birds, and possibly lizards, appreciate comparatively minute differences of shape and colour, yet it is quite conceivable that they cannot distinguish these at a greater distance than a myopic man. We know even less about the sense impressions of insects, in spite of the patient observations of Forel and Lubbock, and the brilliant experiment of Exner. The whole subject is discussed in detail by Dr. Auguste Forel, who seems to have established the fact that insects have a very keen perception of movement—possibly far more acute than their sense of form and colour.* It has often occurred to me when collecting butterflies that it is just possible that they can smell a collector as far as they can see him.

§ 7. *Notes on the flight of sundry Butterflies.*

Too many systematic works deal with insects as mere cabinet specimens, though there are notable exceptions. Not the least valuable part of the late Mr. C. G. Barrett's great work on the "Lepidoptera of the British Islands" is his vivid description of their habits and flight. Again in Moore's "Lepidoptera of Ceylon" the short notes on the mode of flight of many species supplied by Capt. H. Wade-Dalton, Mr. F. M. Mackwood and more frequently Capt. F. S. Hutchison are of great interest. The value of the notes in the last-named work is not diminished by the fact that the observers are not always agreed. The habits of the sexes are usually different; the time of day, not to speak of the weather, greatly affects their flight; probably the time that has elapsed since emergence from the pupa is

* *Forel*, "The Senses of Insects." Translated by Macleod Yearsley, 1908, *passim*.

another important factor. Hence it follows that hasty generalisations based on the most accurately recorded observations may be most misleading if the qualifying circumstances be left out of account.

The first fact that I would emphasise is the rapid flight of the Whites and Yellows.* That Pierines may be seen fluttering slowly about flowers is true enough,—*e. g.* that *Colias edusa* is not always difficult to catch. Nevertheless Pierines have a knack of flying straight on, as if bound to reach some distant place at a definite time, in a way that Satyrines certainly are not given to. Again, though the Nymphaline may go off at a great pace for a short distance, it usually soon returns to its beat. Among many swiftly flying Pierines that I have come across, are:—*Catopsilia* and the allied genera *Callidryas*† and *Gonepteryx*; the Neotropical *Glutophrissa drusilla*, Cram., and more especially *Pieris phileta*, Fabr.‡; the powerful Oriental *Hebomoia*§; again *Ixias pyrene*, Linn.,‖ though not equal to the last named, is a swift flier, as are also many of the *Teracoli*, notably the South African *T. eris*, Klug.¶

Commander J. J. Walker, R.N., writing of *Euchloë belemia*, Esp., at Gibraltar, Tangier, etc., said: "It has a very strong, swift, and erratic flight, and is by no means easy to catch."** Even the little *Terias*, which *seems* to go slowly, will be found to move so fast that a large proportion get away, though in this instance the mode of escape is commonly to dart downwards so that the net passes over it, and to the annoyance of the collector the fly rises from the ground.†† There seems to me to be practically no doubt that the swift flight of the Whites and Yellows is due to their exceptional conspicuousness as compared with other butterflies. That they *are* exceptionally conspicuous is obvious enough.

But not all Pierines are rapid fliers; there are marked and significant exceptions. Thus, many years ago, Mr. A. R. Wallace,‡‡ writing of the Oriental genus *Thyca* (*Delias*), said: "They have a very slow and weak mode of

* Trans. Ent. Soc. Lond., 1905, pp. 67, 75, 76, 112.
† *Ibid.* 1908, p. 55.
‡ *Ibid.* 1908, p. 49.
§ *Ibid.* 1905, pp. 116, 126, and subsequent experience in Ceylon.
‖ *Ibid.* 1905, p. 79. Also MS. notes in Ceylon, 1908.
¶ *Ibid.* 1907, p. 352.
** *Ibid.* 1907, p. 48.
†† *Ibid.* 1890, p. 369.
‡‡ *Ibid.* 1865–8, p. 309.

flight." Again at East London Dr. Dixey * called my attention to the 'slow, fearless, fluttering flight' of *Mylothris agathina*, Cram. Both *Delias* and *Mylothris* furnish well-known models, closely mimicked by other Pierines. Dr. Dixey noted that the flight of the mimic *Belenois thysa*, Hopff., closely resembled that of its model *Mylothris agathina*, but Mr. E. E. Green tells me that *Prioneris sita*, Feld., a very close mimic of *Delias eucharis*, Cram., is a swift flier.

Probably belonging to a different category are two smaller Pierines of dissimilar structure, but similar appearance, the Palæarctic *Leucophasia sinapis*, Linn., and the Oriental *Nychitona xiphia*, Fabr.,† which are among the very feeblest fliers of my acquaintance.

The slow gliding, floating (Hutchison), or skimming flight of certain Nymphalines such as *Neptis*, *Rahinda*, *Ergolis* and *Eurytela* is well known to tropical collectors, what its significance may be I know not. My experiments indicate that *Ergolis* is palatable.‡

It has not been my good fortune to capture that fine butterfly *Parthenos cyaneus*, Moore, but at Kandy I watched its tantalising movements for some time as it flew to and fro far above my longest net-stick. Messrs. De Nicéville and Manders say of this species :—"not rare, but is difficult to catch. It has a remarkably distinctive mode of flight, which makes it recognisable at once on the wing." § As those gentlemen make no endeavour to describe its peculiarity I will do my best to do so. The wings appear to be seldom raised much above the horizontal, but at comparatively long intervals they are strongly depressed with a jerk, the fly then gliding along for two or three yards. In marked contrast to this is the flight of *Papilio parinda*, Moore, which is attended with obvious flapping in which the wings are much raised but not appreciably depressed below the horizontal. I am glad to be able to add that Mr. E. E. Green agrees with the general accuracy of this description.

The slow heavy flight of the Danaines is of course familiar; I might specially mention *Crastia asela*, Moore, *Narmada montana*, Feld., *Chittira fumata*, Butl., and *Parantica aglea*, Cram. I am not aware that the peculiar dancing

* Trans. Ent. Soc. Lond., 1907, pp. 314, 325.
† *Ibid.* 1905, p. 79. Also Ceylon, 1908. ‡ *Supra*, pp. 124, 125.
§ Journ. Asiatic Soc. of Bengal, vol. lxviii, 1899, p. 188.

movement—up and down—of the two last-named has been placed on record: yet it is often so marked as to enable one to diagnose the insects at a considerable distance. At Kandy late in the afternoon, when other butterflies were getting scarce, *P. aglea* might often be seen slowly dancing about in all directions.

At the falls of the Zambesi I noted *Papilio leonidas*, Fabr., as flying slowly "with the manner of a Danaid"; this made me suspect it to be a mimic, as I afterwards found to be the case.* Mr. Marshall, who is quite familiar with the insect, whereas I have seen but very few specimens, speaks of *P. leonidas* as having a strong and rapid flight, and always going straight ahead.† I think there must have been some special circumstance that caused my specimens to behave in an unusual manner. Certainly its alleged model, *Tirumala petiverana*, did not put in an appearance.

The flight of *Cethosia nietneri*, Feld., another Ceylon butterfly, is I think about the slowest and feeblest that I have observed, and this alike whether it be high up or near the ground. (MS. notes.) The S. African Nymphaline *Salamis anacardii*, Linn., is another remarkably slow flier.‡

As a general rule tropical butterflies seem harder to catch than British. Certainly this is not entirely to be explained by the heat, nor even by swiftness of flight. The slow-flying *Mycalesis* seldom moves far, and is for that very reason hard to catch as it seldom gets quite clear of the herbage amongst which it is found. Again *Elymnias* often refuses to move more than two or three yards when disturbed, yet is hard to catch because it will not get clear of the bushes in the middle of which it loves to flutter. A very different butterfly, the lovely blue *Nepheronia ceylanica*, Felder, a quick flyer, often takes refuge in bushes when pursued; *Teracolus puellaris*, Butl., has a similar habit. *Belenois mesentina*, Cram., and the two common Indian species of *Ixias* seem to spend much of their time flying through and through thorn bushes.§

Three years ago ‖ I called attention to the curious habit of the ♂ *Catophaga paulina*, Cram., of flying in strings as though tied together by an invisible thread. I witnessed this

* Trans. Ent. Soc. Lond., 1907, p. 359.
† *Ibid.* 1902, p. 507.
‡ *Ibid.* 1906, p. 114; also *Ibid.* 1907, pp. 321, 322, 325.
§ *Ibid.* 1905, pp. 75, 80, 89. ‖ *Ibid.* p. 130.

again at Haragáma, Ceylon, 20 January, 1908. Soon after mid-day large numbers of the ♂ were seen flying down the bed of the stream, sometimes in ones and twos, but often 3, 4 or 5 together in strings. On the same day clusters of a score or more were seen drinking at wet sand; when disturbed they would quickly come back to the favoured spots, as many as 5 to 7 together, in strings, all conforming to the movements of their leader like wild geese.

Melanitis leda, Linn., is an insect with which I have been unfortunate, never having come across it in any numbers. At the beginning of February 1908, I twice witnessed its evening flight—at about 6·30 p.m. when it was nearly dark. My net-stick consists of two lower joints of a salmon-rod; on the occasion referred to the butt-joint, which is partly covered with cork, was lying near me on the ground. The butterfly flew in jerks, making short circuits and returning again and again to settle on my hat, my net, or the net-stick on the ground. It struck me at the time that it might probably be guided by the sense of smell, especially as it selected the part of my net-stick that was most handled. Yet it is quite possible that the butterfly was attracted by my white tropical clothing, and by the light colour of the cork, which was fairly conspicuous in the increasing gloom under the palms. One evening when strolling in the hotel garden alone in search of *leda* a leaf of a coco-nut palm fell close to me with a positive crash; when one considers that it measured between 11 and 12 feet long it can be understood that I was not a little startled.

The Ceylon Papilios would appear to be more easily netted in the afternoon than in the morning; this is especially the case with *Ornithoptera darsius*, Gray, and *P. parinda*, Moore.

P. demoleus, Linn., is swift of flight; so is *P. agamemnon*, Linn., which has a darting movement. The last-named is quite an inconspicuous butterfly whether on the wing or at rest, affording a marked contrast to the glorious *P. erino*, Fabr., which is almost startling in its brilliance.

The flight of *P. hector*, Linn., is not especially swift, but is marked by the straightness of its course, seeming to keep on one level. Its black, white and scarlet colouring is very obvious in flight, and the strong contrast of colours seems to make the movement of its wings more obvious and more rapid in appearance.

In marked contrast with the last is *P. aristolochiæ*, Fabr., which sails about slowly and quietly with little obvious flapping of the wings; it moves about in a stately way as if confident in its immunity from attack and is the most easily caught of all the group.

P. polytes, Linn., two of whose polymorphic ♀ mimic *hector* and *aristolochiæ* respectively, behaves very differently from them and seems to trust much to swiftness of flight; my observations chiefly relate to the ♂, and I have an impression that the flight of the ♀ is slower, but this requires confirmation. Though well known to Indian entomologists I am not aware that the contrast in flight between *polytes* and *aristolochiæ* has yet been placed on record.

It is a notable habit with many Papilios that when settled on flowers feeding they keep their wings in almost constant movement.* This has been noted in all the following species:—*O. darsius*; this when feeding occasionally stops fluttering, dropping the fore-wings back (towards the abdomen); *P. parinda*, *P. hector*, *P. aristolochiæ*, *P. polytes*, *P. agamemnon* (the habit is very marked in this species), *P. demoleus*, *P. demodocus*, *P. dissimilis* and *P. mooreanus*, Rothsch. (a race of *helenus*, Linn.).

I was much struck by specimens of the last-named in the forest at Hatton, Ceylon (5 March, 1908), settled on very dark grey rocks drinking, with their wings about ¾ expanded, but with the fore-wings drawn back so as almost entirely to conceal the conspicuous cream-coloured spot on the hind-wings. For the moment I thought that there was before me some other species, entirely black on the upper side.

P. teredon, Feld. (*sarpedon*, Linn.), and *P. jason*, Esp. (*telephus*, Feld.), do *not* flutter when drinking.

§ 8. *The selection as resting-places of Yellow Leaves by Yellow Butterflies.*

As there still appear to be entomologists of wide experience who doubt whether butterflies, impelled by instinct, ever select resting-places of like colour with themselves,

* *Longstaff*, "Some Rest Attitudes of Butterflies," Trans. Ent. Soc. Lond., 1906, p. 111.

it seems worth while to bring together the following observations.*

It is a singular coincidence that on passing through the garden of the University of Bombay, 22 March, 1908, I again saw a *Catopsilia* and watched it settle on a shrub: this was not a yellow-leaved plant, as on the former occasion, but its leaves varied a good deal in colour and the butterfly *settled on the yellowest*: it was certainly much less conspicuous than it would have been on the greenest leaf: a German fellow-traveller whose attention I called to the butterfly agreed as to the partial concealment by the similarity in colour.

Barbados, 18 December, 1906. A ♀ of *Callidryas eubule*, Linn., was seen, when a cloud passed over the sun, to flutter about some herbage for a short time, as though looking for something, and finally to settle on a yellow leaf of the "Life Plant," *Bryophyllum calycinum*, Salisb.

Constant Spring, Jamaica, 8 January, 1907. Two specimens of *C. eubule* (sex not recorded) were seen when the sky was dull to settle on the lower, yellowish leaves of *Plumbago scandens*, Linn., close to the ground.

Mackfield, Jamaica, 27 January, 1907. I was watching the movements of a ♂ *C. eubule*, when a cloud passed over the sun; after fluttering about for a very short time it settled in the middle of a yellow, lower leaf of the *Bryophyllum*.

Montego Bay, Jamaica, 4 February, 1907. A ♀ *C. eubule* was seen flying across the race-course. The track was carpeted with short grass of a rich full green, but amongst the grass were long trailing stems of the *Ipomœa pes-capræ*, Sw.; on one of these stems was a solitary bright yellow leaf, far from any other of like colour, on this the yellow butterfly settled.

Montego Bay, Jamaica, same day. A ♀ *C. eubule* was seen to settle on an isolated yellow leaf of a creeper in a hedge, about 6 feet from the ground, all the surrounding foliage being green.

* See *Longstaff*, Trans. Ent. Soc. Lond., 1906, pp. 113–118. Also *Dixey*, Proc. Ent. Soc. Lond., 1906, p. xxix, who, in the discussion following the reading of the paper first quoted, gave several interesting instances from various authors. Also *Hamm*, Proc. Ent. Soc. Lond., 1904, p. lxxv; 1905, pp. lxxiii–lxxvi; 1906, pp. c, ci.

Constant Spring, Jamaica, 4 January, 1907. A dull afternoon: a ♀ *Terias euterpe*, Mén., was seen to settle close to a leaf of its own size, shape and colour.

Same place and day. A ♂ *T. euterpe* was watched for some time and repeatedly disturbed; it seemed to avoid dark green foliage, and always settled on a low plant with yellow-green leaves.

Mackfield, Jamaica, 27 January 1907; 4.30 p.m. A specimen of *T. euterpe* seen to settle four times as follows:—

(1) On a yellowish leaf of *Bryophyllum*: it was, however but ill-concealed thereby.
(2) On a *pale* green leaf.
(3) On a yellowish-green, finely-cut fern (*Adiantum* sp.).
(4) On a yellow-green leaf of a *Convolvulus* (or perhaps *Ipomœa*). In this case the concealment of the insect was remarkable.

Same place and day. Another specimen of *T. euterpe* was seen to settle on the under side of a yellowish leaf of the *Bryophyllum*.

Same place and day. A ♀ of *T. euterpe* was seen to settle three times:—

(1) On a yellow leaf of *Bryophyllum*; fairly cryptic.
(2) On a light green leaf of an unknown plant, somewhat cryptic.
(3) On a leaf of *Bryophyllum* less yellow than (1), the result less cryptic.

Mackfield, Jamaica, 31 January, 1907. Three specimens of *T. euterpe* (sex not determined and specimens not preserved) were watched with the following results respectively:—

(1) Seen to settle on a yellow leaf of *Bryophyllum*.
(2) Seen to settle three times, twice being on yellow leaves of *Bryophyllum*.
(3) Seen to settle seven times. Twice on yellow leaves of *Bryophyllum* (in one case it was *very* well concealed); twice on a yellow fern (? *Polypodium* sp.); one other time it was well concealed, but the plant not noted; on two occasions it was less well concealed.

Constant Spring, Jamaica, 1 January, 1907. A ♀ of *Terias* (? *clathea*, Cram.) was seen to settle in the shade on a leaf of the same colour as the under-side of its hind-wings.

Haragáma, Ceylon, 13 February, 1908. I watched a specimen of *Ixias pyrene*, Linn., f. *cingalensis*, Moore, a ♀, settle three times upon the yellowish leaves of the same (now) widely distributed *Bryophyllum.**

It should be noted that the faded leaves of the *Bryophyllum* have their margins tinted a purplish-red, resembling in colour the markings found on the under side of dry-season specimens of *Callidryas eubule* and *Ixias pyrene.*

With such facts before me I cannot but believe that the butterflies in question instinctively sought out leaves more or less closely resembling themselves in colour, with a view to concealment.† Undoubtedly the most conspicuous butterflies on the wing are "Whites" and "Yellows." On the move they are protected by their extremely rapid flight, but when at rest they stand in need of special protection. Many of these butterflies are restless and rarely settle, except to feed on flowers, to drink at damp places, or in the case of females to oviposit. To see them go to rest requires both time and patience; the best way being to watch them the moment that a cloud passes over the sun. I have very little doubt that our own Brimstone and Clouded-yellows if watched patiently will be found to seek out yellow resting-places.‡

§ 9. *Heliotropism.*

In a paper read before this Society in March 1906,§ I laid stress upon the habit of many butterflies, when settling in the sunshine, and—when not interfered with by wind or the exigencies of getting food—placing themselves with expanded wings and with their tails turned

* It is perhaps worth recording that at Kandy, in the spring of 1908, the ♂ of *Catopsilia pomona* was on dull days several times beaten out of *Tithonia diversiflora*, a tall, rank-growing, yellow-flowered Composite, said to have been recently introduced into Ceylon from Mexico, and now spreading rapidly. The butterfly seemed to rest among the leaves near the tops of the shoots, but I was not able actually to see it at rest.

† Compare Mrs. Barber's observation on the care exercised by *Papilio dardanus*, a ♂, in selecting a suitable resting-place. *Trimen*, South African Butterflies, vol. iii, p. 254. Quoted by *Marshall*, Trans. Ent. Soc. Lond., 1908, p. 122.

‡ Dr. T. A. Chapman *has* seen *C. edusa* select yellow leaves to rest upon. Proc. Ent. Soc. Lond., 1904, p. lxxvi.

§ Trans. Ent. Soc. Lond., 1906, p. 97–106.

towards the sun. For shortness of expression I described a butterfly so placed as "oriented." The butterflies observed were for the most part Satyrines and Nymphalines, and the observations were made in Northern India, Algeria and South Africa, as well as in England. Without pledging myself to any explanation of this habit, I was inclined to attribute it to the diminution of its shadow when the orienting butterfly closed its wings, whereby the insect was rendered very inconspicuous.

To the number of orienting butterflies previously given may now be added the Neotropical Nymphalines, *Precis lavinia*, Cram., *Anartia jatrophæ*, Linn., *A. amalthea*, Linn., *Victorina stelenes*, Linn., and *Cystineura dorcas*, Fabr.

The details, taken from my note-book, follow:—

Constant Spring, Jamaica, 8 January, 1907. *Precis lavinia*, Cram., f. *zonalis*, Feld. Not uncommon, but hard to catch; usually settled on the ground with wings open; seen to orient and to put its wings up, causing little shadow; also to adjust itself after settling, so as to make the orientation more perfect; but also seen to face the sun.

Maraval, Trinidad, 19 December, 1906. *Anartia amalthea*, Linn. Flies near the ground; settles with wings three-quarters open; orients, but not always.

Same place and day. *Anartia jatrophæ*, Linn. Has a ghostly flight; settles on the ground; orients.

Colon, Panama, 28 December, 1906. *A. jatrophæ*. This species orients, but not very regularly.

Constant Spring, Jamaica, 3 January, 1907. *A. jatrophæ*. Orients, but not very accurately; often closes its wings, and is then very cryptic among whitish dead grass.

Same place, 5 January. *A. jatrophæ*. The commonest Nymphaline: flies fast, close to the ground, looking very white. Usually settles on the ground or close to it; does not frequent flowers much; settles with the wings fully expanded, but often closes them over its back. Orients, but not accurately. Has however been noted with its wings up facing the sun; also once or twice across the sun.

Ramble, Jamaica, 24 January, 1907. *A. jatrophæ*. Orients.

Montego Bay, Jamaica, 2 February, 1907. *A. jatrophæ*, seen twice to settle on the whitish sand of the sea-

shore, to orient and close its wings, making no shadow.

Port Antonio, Jamaica, 4 March, 1907. The sun nearly vertical. *Victorina stelenes*, Linn., settled on leaves, once facing the sun, once head downwards, tail to the sun, wings closed and no shadow.

Ramble, Jamaica, 24 January, 1907. *Cystineura dorcas*, Fabr. Flies very slowly, close to the ground. Settles with wings nearly wide open, but it sometimes closes and then quickly re-opens them. When feeding on flowers, especially the Composite, *Bidens leucanthus*, W., it is indifferent as to its position with regard to the sun, but otherwise it usually orients, though it occasionally faces the sun.

Observations in Ceylon, 1908.

Precis iphita, Cram. This species was often observed. It most often settled with its wings closed, but frequently they were fully expanded. Though one specimen was seen to settle twice across the sun, it more usually either faced the sun or turned its tail to it.

Yphthima ceylanica, Hew. Ceylon. This species, which keeps close to the ground, settled occasionally with the wings open, more often half open, but most commonly closed. As regards orientation, it was noted to have its tail to the sun 10 times (once by adjustment), as against 7 times that it was across the sun.

Ergolis taprobana, Westw., and *E. ariadne*, Linn. May be conveniently taken together. They have a skimming or gliding flight which is not always checked by rain. They settle commonly with their wings fully expanded, but sometimes close them only to open them again. Most often they orient, but sometimes imperfectly; one was seen to adjust itself.

Nissanga patnia, Moore. This butterfly settled with its wings up (one exception) and so far as I observed with the eye-spot exposed. In the majority of cases it oriented.

Neptis jumba, Moore; *N. varmona*, Moore; and *Rahinda sinuata*, Moore. These three species may be conveniently taken together. They all have the same gliding flight and all settle most frequently with the wings fully expanded, though often closed. As regards orientation less than half the specimens observed appeared to pay any

attention to the direction of the sun's rays, though one *varmona* was certainly seen to adjust its tail to the sun.

Castalius rosimon, Fabr. Two specimens seen to orient with wings up.

Some English Satyrines.

I have previously recorded my experience * that in the great majority of cases *Pararge ægeria*, Linn., and *P. megæra*, Linn., settle with their wings expanded and with their tails pointed towards the sun, though occasionally both species sit across the sun, but even in that case with wings expanded.

The following note may be added:—

Mortehoe, 14 September, 1907, late afternoon. *P. megæra* found asleep upon the face of a rock, about 3 ft. above ground: its head up, antennæ porrected but separated; wings in close contact; fore-wings drawn back so that no fulvous colour was exposed.

Epinephele tithonus, Linn.

The following observations show that the habits of this butterfly, as regards orientation, are similar to those of *Pararge megæra*.

Mortehoe, 20 July, 1906. *E. tithonus*. A specimen observed settled across the sun, with wings closed.

Same place and day. Another specimen seen to settle twice; oriented, with wings open.

Mortehoe, 11 August, 1907. A specimen settled on the ground, oriented, wings three-quarters open.

Mortehoe, 15 August, 1907. A specimen settled on grass; across the sun, wings closed. It was disturbed by a ♂ *E. janira*, it settled again and this time oriented and closed its wings, making no shadow.

Same place and day. A ♂ settled on a leaf, oriented wings open.

Same place and day. A ♂ seen to settle three times on leaves, with wings open; twice it faced the sun and then partially adjusted itself; the third time it oriented correctly.

* Trans. Ent. Soc. Lond., 1906, pp. 98, 99.

Same place and day. A ♂ settled on grass, oriented, wings half to fully open.

Same place and day. A ♀ on a bramble leaf, oriented, wings three-quarters to fully open: it was twice observed to close its wings leaving little shadow; the eye-spot on the fore-wing was exposed.

Same place and day. A ♂ on a leaf of *Heraeleum*, wings three-quarters open, oriented; it momentarily closed its wings, leaving no shadow.

Same place and day. A ♂ on a bramble leaf, oriented, wings three-quarters open.

Same place and day. A ♂ on a bramble leaf, wings quite open, imperfectly oriented.

Same place and day. A ♀ twice seen settled across the sun, wings closed, but eye-spot visible.

Mortehoe, 22 August, 1907. A ♀ oriented, wings three-quarters open.

Mortehoe, 24 August, 1907. A ♂ half-oriented.

Same place and day. A ♀ on a leaf, imperfectly oriented.

Epinephele hyperanthus, Linn.

This is a restless butterfly, and takes long to settle; however, I have this note:—

Mortehoe, 20 July, 1906. Four *E. hyperanthus* seen to orient, with wings three-quarters open.

§ 10. *"List" and Shadow.*

In my paper on some Rest-attitudes of Butterflies, I gave instances of Satyrine butterflies which usually close up their wings when settled and have a habit of then leaning over to one side. This I termed a "list." The object of the manœuvre appeared to be to aid concealment, but my first observations were imperfect in the important respect that the direction of the list, whether towards or away from the sun, was not recorded. The fact of listing was observed by me in India and Japan, and by Dr. Dixey and myself in England and South Africa.*

To the "listing" butterflies I am now able to add, from my own observations, a Neotropical species, also belonging to the *Satyrinæ*.

* Trans. Ent. Soc. Lond., 1905, pp. 135, 136; also 1906, pp. 109–111.

Calisto zangis, Fabr.

This is quite a shade-loving butterfly; it keeps close to the ground flying amongst herbage, usually for a very short distance at a time. It was once seen flying freely on a rainy day.

Mackfield, Jamaica, 29 January, 1907. Three *C. zangis* seen to settle (one of them twice) with a list away from the sun of about 30° (from the vertical).

Christiana, Jamaica, 2 February. *C. zangis* seen to list away from the sun.

Mile Gully Mt., Jamaica, 14 February. *C. zangis* seen to settle and then, with a jerk, list about 30°.

Port Antonio, Jamaica, 4 March. Three *C. zangis* seen to list from the sun, usually but 20°–30°; one was seen to increase the list in two movements.

During my visit to Ceylon in the spring of 1908 I did not see any butterflies list.

Cœnonympha pamphilus, Linn.

Early in June 1906 Mr. W. J. Kaye told me that he had recently noted in Surrey the common *C. pamphilus* settle with its wings up, but leaning over in such a way that the sun's rays fell vertically upon its wings. Going down to Devonshire the next day I naturally wished to confirm Mr. Kaye's observation, but though I have seen the butterfly in some abundance at Mortehoe its appearance there is most uncertain, so much so that neither in 1904 nor in 1907 did I come across a single specimen in the parish! However, in 1906 I did succeed in finding three specimens which I observed with the following results.

Mortehoe, 10 June, 1906. *C. pamphilus*: a specimen seen to settle six times; always across the sun; with head sometimes to the right, sometimes to the left; the wings up; in every case with a list away from the sun so that its rays were about normal to the wing surface.

Mortehoe, 13 June, 1906. A specimen seen to settle several times; across the sun; the wings up, but with no list.

Mortehoe, 14 June, 1906. A specimen seen to settle 16 times; always with wings up and across the sun; on 12 occasions with a list away from the sun.

Braunton Burrows, 10 Sept., 1907. *C. pamphilus* (the only one seen that year) settled across the sun, with head to the wind, and a list away from the sun.

Morte Point, 5 September, 1908. *C. pamphilus* rather common at one spot; the wind was so strong as to compel them to keep their heads to it regardless of the sun. A specimen was seen to list three times to the right, slightly, and once to the left, strongly.

Satyrus semele, Linn.

The behaviour of this butterfly may be compared with that of the last-named.

Mortehoe, 20 July, 1906. A number of *S. semele* observed to settle. All put their wings up; two oriented with tail to sun; one faced the sun; 24 placed themselves across the sun, of these one was noted as listing about 30° towards the sun, but eight listed away from the sun, only one however to an extreme degree.

Same place and day. Three *S. semele* put into a large glass-covered box. Observed the same afternoon, at 6 p.m., in sunlight; all three were sitting across the sun and listed away from it 35°, 45°, and 55° respectively.

Mortehoe, 31 July, 1906. Several *semele* noted, settled across, and tilted a *little* away from the sun.

Mortehoe, 22 August, 1907. Three *semele* observed at rest, all across the sun and listed away from it 30°, 40°, and 25° respectively.

Lundy Island, 27 August, 1907. A *semele* listed away from the sun about 50°.

Here I may insert an observation made by Mr. E. G. Waddilove at Bournemouth in the autumn of 1906 :—

> "A grayling settled on a patch of bare black peat-earth, shut up its wings vertically and crawled at once some two yards to the edge of the patch to where some fir-needles, a cone or two, and a few brittle twigs were lying, and then becoming stationary threw itself over at an angle of some 45° square to

the sun. It thus became quite indistinguishable from its surroundings." (From a letter to the author.)

The late Mr. C. G. Barrett, in an admirable account of the habits of the same butterfly, wrote as follows :—

". . . it even seems to lie down sideways, or at any rate to so greatly slope its closed wings as to appear prostrate." *

Epinephele janira, Linn.

The case of our commonest butterfly is especially interesting, since its habits are irregular and partake of those of *C. pamphilus* and *S. semele.*

Mortehoe, 20 July, 1906. *E. janira.* Four specimens oriented; of these, 3 had the wings open, 1 closed. Eleven specimens were settled across the sun, with wings closed; certainly one of the latter listed from the sun.

July 30. Some noticed to orient; others sitting across the sun.

Mortehoe, 11 August, 1907. 1 ♂ and 2 ♀ oriented; wings three-quarters open. Others seen across the sun and one of these listed. The wind was however this day too strong for trustworthy observations. The butterflies mostly sat head to the wind.

Mortehoe, 15 August, 1907. Several specimens noted settled on grass, on or near the ground. Of these 3 ♂ oriented, 1 with the wings quite open, the other 2 three-quarters open. A ♀ oriented with the wings open; another ♀ settled on a leaf oriented with the wings three-quarters open. Another ♀ sat across the sun, had its wings up, and listed away from the sun. The eye-spot on the fore-wing sometimes obscured, sometimes in part visible.

Mortehoe, 16 August, 1907. A ♀ seen to settle three times across the sun, with its wings closed, leaning away from the sun. Yet another ♀ was seen to settle three times; twice across the sun, with wings closed, but on the third occasion with its wings open and fairly oriented.

* "Lepidoptera of the British Islands," 1893, vol. i, p. 35.

Mortehoe, 22 August, 1907. A ♀ observed to settle three times, (1) oriented; (2) across, with slight list away from the sun; (3) oriented.

August 24. A ♀ settled on a leaf oriented.

The effect of a list on the shadow.

It is worth while carefully considering the precise effect of a list on the shadow of a butterfly sitting with the axis of its body at right angles to the sun's rays.

To make the matter clear I have constructed three diagrams. The diagrammatic butterfly is in each case

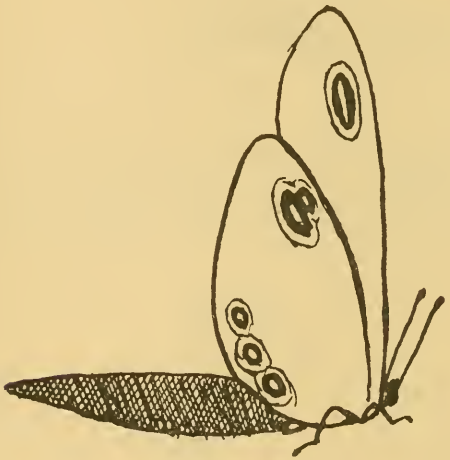

Diagram A.
Butterfly upright, sun's elevation 50°.

supposed to be settled with its tail towards the observer, but turned somewhat to the left so as (in two of the three diagrams) to expose the underside of the right wings obliquely to the observer. The sun is supposed to be to the right of the observer and nearly to the right of the butterfly. The sun's elevation is taken to be 50°, representing a condition of affairs that is fulfilled in Europe during some part of every day near midsummer, and in the tropics during some part of every day in the year.

When the butterfly is upright its shadow is nearly as long as its wings, moreover its shadow is fully exposed to view. (See diagram *A*.)

If the butterfly were to list towards the sun its shadow, still fully exposed to view, would diminish until the list were equal to the sun's altitude, when there would be no shadow. In this position, moreover, its wing surfaces would be least illuminated.

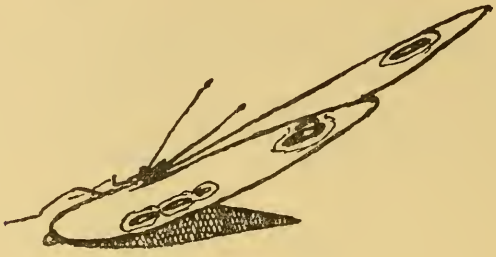

DIAGRAM B.
Butterfly listing, more than 60° towards the sun.

Supposing the butterfly to increase its list; this would bring the sun's rays on to the under surface of its left wings and so throw the shadow to the right, or towards the sun. (See diagram *B.*) The shadow would continue to

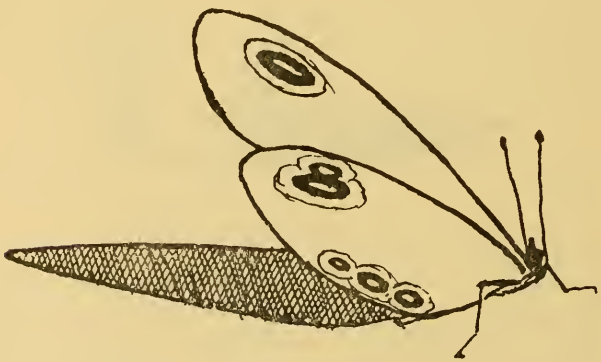

DIAGRAM C.
Butterfly listing, 40° from the sun.

increase in length until when the butterfly's wings touched the ground it would equal them in length. On the other hand, as the shadow increased in length it would be more and more concealed from view.

But as a matter of fact the list has almost always been observed to be *away* from the sun. Such a list increases

the length of the shadow until the list amounts to 40° (under the conditions assumed) and so brings the wings into a position normal to the sun's rays. (See diagram *C.*) The length of the shadow is then at its maximum and longer than the wings.

A further list will diminish the shadow until when the wings touch the ground it will equal their length.

A little consideration will, however, show that by listing the butterfly, so to say, covers up its own shadow more and more, so that while a slight list produces little effect on the shadow, a considerable list—45° and upwards—makes the shadow less conspicuous than that cast by the same butterfly in the upright position.

My conclusion accordingly is that, so far as regards the shadow cast, no list *from* the sun can be protective to the insect unless it be extreme. Again, a list *from* the sun, by resulting in the maximum illumination of the wing surface, can hardly aid concealment. At the same time, it cannot be denied that a butterfly by placing itself out of the upright, may thereby be protected in so far as it may then be more difficult to detach it from its surroundings. This would certainly appear to have been the case with the *Melanitis* recorded by Col. Bingham* and by "E. H. A.," † also with the *S. semele* observed by Mr. E. G. Waddilove.

Dr. Chapman tells me that he has observed a marked list in a Spanish species of *Erebia,* and my own experience of list is confined to the Satyrines, a group of feeble fliers, be it noted, with (at any rate in the great majority of species) cryptic under-sides. I am, however, aware that Prof. Poulton and Mr. Rowland-Brown have observed an extreme list in *Thecla rubi,* Linn.; possibly connected with the green colour of the under-surface of its wings.‡

Barrett's remark as to a rarer British butterfly, *Grapta c-album,* Linn., deserves quotation:—

> ". . . fond of sunning itself in roads, on warm walls, or on the ground upon dead leaves in sheltered valleys. Here if the sun becomes overclouded, it will sometimes close its wings and almost lie down, in such a manner that, to distinguish its brown and

* Trans. Ent. Soc. Lond., 1902, p. 363. See also "Butterflies of India," vol. i, p. 47. † "A Naturalist on the Prowl," p. 203.
‡ Proc. Ent. Soc. Lond., 1906, p. xxviii.

green marbled underside from the dead leaves is almost impossible." * Here Barrett says *if the sun becomes overclouded*, but I have observed the list during bright sunshine only.

When my attention was first drawn to the subject of Heliotropism by observing the habits of *Pararge schakra*, Koll., in the Simla district in October, 1903, I was disposed to associate that habit with another—that of listing to one side or the other—and suggested that both had probably been selected since they appeared to assist to a notable degree in the concealment of the insect from its foes.†

The evidence now available is more ample though still far short of what would be requisite in my opinion to establish definitely any explanation.

Prof. Parker's explanation that by negative Heliotropism the insect displays its colouring to the best advantage, can scarcely be applied to list, for while it may be true that by listing a butterfly displays its under-side, that under-side is in listing butterflies usually cryptic, even when in our cabinet it appears the more brilliant of the two. Moreover, in the listing position the most conspicuous feature of the pattern is often concealed by the hind-wing.

That under special circumstances there is an "economy of shadow" in both heliotropic and listing butterflies is unquestionable. On the other hand, the negatively heliotropic butterfly with wings expanded, and the listing butterfly with wings closed, both place their wings as nearly as may be normal to the sun's rays, exposing in the one case their upper, in the other their under, surface. Is it possible that the direct rays of the sun falling normally on either surface of the wings, afford a pleasurable sensation to the insect? Or is the exposure of the insect's *body* to the sun, common to some extent to both these attitudes, the end obtained? The obvious love of most butterflies for hot and sunny corners unquestion-

* *Op. cit.* p. 125.

† Mr. Marshall writes to me that he has observed in the case of three S. African butterflies, *Precis cebrene* and *Hamanumida dædalus*, at Salisbury, and *Mycalesis campina*, Auriv., in Chirinda forest, that when they have been sunning themselves they have closed their wings with a snap when a heavy cloud has passed over the sun.

ably suggests some such explanation. Perhaps the two explanations may both be true, that heliotropism and list combine the pleasures of insolation with the minimum of risk.* It must, however, be remembered that the listing butterfly exposes to the sun *one* hind-wing only, and a small portion of one fore-wing.

§ 11. *The inverted attitude of Lycænids and some other Butterflies.*

Supplementing the observations recorded in my paper on "Some Rest Attitudes of Butterflies"† I may add the following notes:—

North Devon, 1 September, 1907. Walking with Mr. H. Champion along the Woolacombe Sandhills late in the afternoon we observed 39 specimens of *Lycæna icarus*, Rott., asleep on Marram, Privet, etc. No less than 38 of these were sleeping with the head down, while the exceptional one was horizontal. In many cases the fore-wings were drawn so far back that the costæ of the hind-wings overlapped those of the fore-wings. The antennæ were porrected and near together.‡

Mortehoe, 11 September, 1907. A ♀ *L. icarus* at rest on a Ragwort flower moved its hind-wings alternately.

* Mr. Marshall calls my attention to the fact that orienting butterflies are always very much on the alert, and do not need cryptic protection.

† Trans. Ent. Soc. Lond., 1906, pp. 106–9.

‡ In the fourth Report of the Rugby School Natural History Society, 1870, p. 17, is an interesting note by Mr. Arthur Sidgwick, which I give at some length as the Report is not easily accessible. "On the 13th August, 1870, I noticed on the road from Bex to Gryon, in the Rhone Valley, a large number of the Chalk-hill Blue (*Polyommatus Corydon*), on the umbelliferous plants by the road-side. It was just sunset, and they were all at rest. Their colour and shape effectually protected them from notice. . . . I noticed that they all rested *head downwards.* It occurred to me that even this apparently trifling detail of instinct or habit might be protective. The eye in wandering over a plant is arrested more easily than one would suppose by any outline *out of accord* with the general lines on which the plant is constructed." The note is accompanied by sketches showing that the butterfly resting head downwards is less conspicuous than one in the opposite position.

Carácas, Venezuela, 3 March, 1907. The dingy little *Catochrysops hanno*, Stoll., was seen sitting head downwards, opening its hind-wings at intervals.

Walderston, Jamaica, 16 February, 1907. *Calycopis pan*, Drury. The lobe of the hind-wing is everted as in *Aphnæus*, *Argiolaus*, etc.

St. Ann's, Trinidad, 1 April, 1907. A ♀ of *Thecla spurius*, Feld., seen sitting head down; the hind-wing is folded; the lobe is large.

The Zebra-like *Thecla linus*, Sulz., is a common species in Trinidad. The lobe of the hind-wing is everted, but not quite to a right angle; it is curious that the tails are *crossed*, so that the tail of the right-wing imitates the antenna of the left side and *vice versa*. Mr. Knight has made this very clear in the figure.

Fig. 1.

Thecla linus at rest: (*a*) natural size; (*b*) the lobe enlarged.

The tails were seen to move slightly, and the "false head" looked more like a head than the real one. Though I have no note to that effect, I feel sure that I saw this species sitting head downwards.

My recent Ceylon experience (Jan.–March, 1908) enables me to add 9 more species, in which I have observed the inverted attitude, making in all 19 species of *Lycænidæ*. It seems probable that sufficient observations are alone required to prove the habit to be general in that family.*

* Compare Trans. Ent. Soc. Lond., 1905, pp. 85, 86, 127. Mr. Marshall writes: "I am quite satisfied that this (head down) is the usual position in *Lycænidæ*, and could add numerous species to your list, such as: *Aphnæus*, *Spindasis*, *Axiocerces*, *Iolaus*, *Stugeta*, *Hypolycæna*, *Mimacræa*, *Nyrina*, etc., etc., but the simplest way is to mention the species which do *not* do it. Of these I know three only in South Africa: viz. *Alæna nyassæ*, *A. amazoula*, and *Pentila*

Zizera otis, Fabr., f. *indica*, Murray. ♀. One observation.
Evcres parrhasius, Fabr. ♀. Two observations.
Nacaduba atrata, Horsf. ♂ One observation.
N. noreia, Felder. One observation.
Jamides bochus, Cram. ♀. One observation.
Lampides elpis, Godt. ♂ Two observations: in one case it settled head upwards, but turned round immediately.
Lampides celeno, Cram. 10 ♂, 1 ♀.
Polyommatus bæticus, Linn. Both sexes. Nine observations.
Surendra quercetorum, Moore. ♀. One observation.
Loxura arcuata, Moore. One observation.

The "sawing" movement of the hind-wings observed at Kallár in the Nilgiris in 1904 in *Lampides* sp., and in *Tarucus telicanus*, Lang, at East London, S. Africa, in 1905, was again observed in several Blues in Ceylon in 1908, viz. :—

Telicada nyseus, Guér.	Six observations.
Everes argiades, Pall.	Two observations.
Lampides celeno, Cram.	Three observations.
Polyommatus bæticus, Linn.	Six observations.

Poulton explains this movement* as assisting in the deception of the "false head," but the explanation scarcely satisfies me since butterflies at rest do not usually move their antennæ. It is however possible that movement as movement may challenge attack; compare the case of the Maina mentioned above.†

As regards the lobes on the hind-wings of so many Lycænids the following facts may be noted as supplementary to previous papers.‡

Aphnæus (*Spindasis*) *vulcanus*, Fabr. Ceylon, 1908.

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tropicalis—all distasteful species. Similarly this is the normal position in South African *Nymphalinæ*, viz. *Atella*, *Lachnoptera*, *Hypanartia*, *Precis*, *Catacroptera*, *Crenis*, *Charaxes*, *Euralia* and *Salamis*, which are all the genera I can think of at the moment in which I have actually observed it. On the other hand, all the *Danainæ* and *Acræinæ* hang with wings down. It is possible this may prove to be a good criterion of palatability, for the head-down position gives the insect a much better opportunity of launching into a rapid flight, and thus evading attack, which is not of such great consequence to distasteful species."

* "Essays on Evolution," 1908, pp. 282, 325, and the references there given.

† p. 630.

‡ Trans. Ent. Soc. Lond., 1905, pp. 85, 86; also 1906, pp. 106–109.

In this species, which has a habit of curvetting rapidly about before settling on the ground, the lobes, which are small, are everted. The hind-wings are folded in such a way as to make a very slight convexity between the two tails, the nervures corresponding to the latter lying in re-entrant angles.

Rapala lazulina, Moore. Ceylon, 1908. The lobes are everted.

Loxura arcuata, Moore. Ceylon, 1908. This species has a peculiar darting flight. The arrangement of the wings at rest is somewhat complicated: the lobes, which are small, are $\frac{1}{2}$, or perhaps $\frac{3}{4}$, everted, showing an eye-spot when the insect is looked down upon from above; the long tails appear to be somewhat twisted—one overlying the other, their black and white tips curved upwards. The

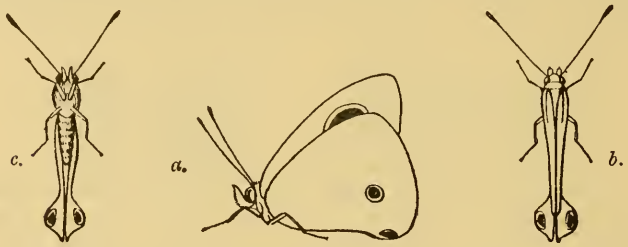

Fig. 2.

Calisto zangis at rest: (*a*) side view, (*b*) from above, (*c*) from below.

portion of the hind-wing between the extremity of the abdomen and the lobe is bent inwards. As touching the very nearly allied Indian species, *L. atymnus*, Cram., I noted at Calcutta in 1903, "its wings are much plaited longitudinally, and when at rest its extremely long tails, crumpled look, and brown colour give it quite the appearance of a dead leaf." *

Neither the inverted attitude nor the everted lobe would appear to be confined to the *Lycænidæ*, as the following examples prove.

The common Jamaican Satyrine, *Calisto zangis*, Fabr., has a peculiarity of construction which appears significant. The anal angle of the hind-wing is somewhat produced, moreover on either under surface, at the angle, there is a small ocellus. When at rest the wings are raised over the back in the usual manner; the abdomen is covered by the

* Trans. Ent. Soc. Lond., 1905, p. 90.

hind-wings, which are folded closely under it, but the anal prolongation of the wing is everted at right angles, as in the lobed Lycænids, and as in their case the ocellus may be seen from above. In every case in which I noted the butterfly at rest it was upon the ground, so that I do not know whether it ever adopts the inverted attitude and is protected by a "false head." But whether that be so or not the approach to Lycænid structure in a Satyrine is interesting.

At first I thought that the eversion of the lobe in *C. zangis* might be due to the pressure of the curved surface of the pill-box in which the butterfly was confined, but subsequently was abundantly convinced that such is not the case, for when the butterfly rests on a flat surface with which the wing does not come in contact it is everted just the same.

There is a well-developed lobe in the Oriental and Ethiopian Nymphaline genus *Cyrestis,* while the allied Neotropical genus *Megalura* has a somewhat similar structure (pointed out to me by Prof. Poulton), but I am not aware that the bionomic significance of these has as yet been worked out.

The fine large blue-grey Nymphaline *Peridromia feronia,* Hübn., is a strong flier, which has the unusual habit of settling upon tree-trunks, usually choosing palms with silvery-grey stems. The butterflies harmonise wonderfully with the silvery-grey stems as they sit with wings fully expanded like Geometers, but always *head downwards* as noticed by Darwin in Brazil.* When disturbed they will return to the same tree again and again. I met with this species at Colon, La Guaira and Trinidad, and noticed these points on each occasion.

Another large Nymphaline which appears invariably to sit head downwards is *Aganisthos orion,* Fabr., of which I saw several in Jamaica. The favourite resting-place seemed to be the trunk of a logwood tree, *Hæmatoxylon campeachianum,* Linn., from 1 to 4 feet from the ground. This species rests with its wings closed above its back, and although the underside is cryptically coloured, the butterfly may be seen from a considerable distance when in profile.

* "Journal of Researches," etc., edn. 1860, p. 33. Compare W. J. Burchell's observations (1825—1836), quoted by *J. C. Moulton,* Ann. Mag. Nat. Hist., Ser. 8, vol. ii, August 1908, pp. 184–7.

The pretty little Nymphaline *Dynamine theseus*, Feld., which I was familiar with in Venezuela, Trinidad and Tobago, often reminded me of a Lycænid in its rapid flight and other ways; thus I several times saw it settle head downwards and then quickly move its wings, though I was not able to get near enough to make out the exact nature of the movement.

§ 12. *The Rest-Attitudes of certain Neotropical and Oriental Hesperids.*

The attitudes assumed by the following Skippers are doubtless familiar enough to many who have seen them

Fig. 3.

Eudamus proteus at rest: (*a*) side view, (*b*) from above.

alive, but nevertheless I think it worth putting them on record, more especially since even such excellent illustrations as those of Plötz represent these insects at rest in positions that they never assume.

Eudamus proteus, Linn. The rest-attitude of this common species, as seen in Jamaica, is very striking. It was noted to rest with all the wings up, but partly open and with the fore-wings much sloped back. At the same time the conspicuous tails remain horizontal, nearly at right angles to the wings; for a great part of their length they overlap, but their extremities are divergent. If Mr. Knight's drawings do not represent this attitude quite as clearly as I should have liked, it is because I was not able

to supply the artist with adequate material. The tails appear to be an impediment to the insect's flight.

The three following species, *Hesperia syrichthus*, Linn., *Anastrus simplicior*, Möschl., and *Ephyriades otreus*, Cram., all rest with the wings fully expanded.

On the other hand, *Carystus coryna*, Hew., and *Catia drurii*, Latr., rest with all the wings up; in the case of the latter the fore-wings are much sloped back. The only specimen of the former that it has been my good fortune to see alive was resting on a mass of silvery-white schist or gneiss which shone in the sun with the same metallic gleam as its "silver-washed" under-side.*

Cymænes silius, Latr., was noted in Tobago to settle with the hind-wings horizontal, the fore-wings raised.

In four species I have noted that the fore-wings (which are somewhat ample) are convex upwards as in our English *Thanaos tages*, Linn., these are: *Gorgythion begga*, Prittw.; *Cycloglypha thrasybulus*, Fabr.; and *Chiomara gesta*, H.S., all met with in Venezuela, and *Systacea erosa*, Hübn., in Jamaica.

Mr. Meyrick includes our *malvæ* and *tages* in the genus *Hesperia*; but the difference in the form of the fore-wings is very obvious during life, as is the difference in the resting attitudes, and the distinctions seem to me to have generic value.

I have noted the folding of the hind-wings in the following Ceylon Hesperids:—*Telicota bambusæ*, Moore; *Parnara mathias*, Fabr.; *Bibasis sena*, Moore, and *Badamia exclamationis*, Fabr.†

Two of the above-named rest with the fore-wings erect, the hind-wings erect, or nearly so, and all the wings much sloped back:—*Parnara mathias* and *Badamia exclamationis*.

The following Ceylon species settle with their wings fully expanded like Geometers:—*Tagiades obscurus*, Mab. (*distans*, Moore); *Caprona* (*Pterygospidea*) *ransonetti*, Feld.; *Hantana infernus*, Feld.; *Celænorrhinus* (*Plesioneura*) *spilothyrus*, Feld. Of these the two last certainly settle on the under-side of leaves; they are neither of them so swift of flight as many of the family, and there is no doubt whatever that the habit greatly aids the concealment of somewhat conspicuous insects. When in Ceylon previously,

* Entom. Month. Mag., 1908, p. 120.

† Compare Trans. Ent. Soc. Lond., 1906, p. 112.

in 1904, I saw *spilothyrus* thus settle, and in the same year in India saw *ransonnetti* do so.*

Though perhaps somewhat out of place I append the beautiful drawing made by Mr. H. Knight (from my sketch and specially set specimens) to illustrate the very peculiar attitude adopted by the common Jamaican Uraniid, *Sematura ægistus*, Fabr. The hind-wings are somewhat fluted, as in *Pararge ægeria*, Linn., the anal angle of the hind-wings is *inverted*, not everted as in the Lycænids. One might naturally suggest as a possible explanation a procryptic resemblance to a dead leaf, but

Fig. 4.
Sematura ægistus at rest, viewed from behind.

the only specimens that I have seen at rest were inside houses whither they had been attracted by light.

§ 13. *Seasonal Dimorphism in Neotropical Butterflies.*

Seasonal Dimorphism has long been a subject of study in the Oriental and Ethiopian regions, but in the Neotropical world comparatively little attention has been paid to it.† A visit of less than four months, and those within the limits of the winter, or dry-season, affords but little opportunity for the investigation of such a difficult question—and the difficulty is increased by the paucity of cabinet specimens bearing adequate data—nevertheless I venture to offer the results of my observations for what they may be worth.

In the Old World we see in certain genera of the Satyrines that the same species exhibit two forms, characterised by the presence or absence of ocelli on the under surface of the hind-wings. Similarly two forms are met with in the Nymphaline genus *Precis*‡; in the one ocelli on the under side of the hind-wings are well de-

* For the similar habit of *Pterygospidea* (*Tagiades*) *flesus*, Fabr., in S. Africa, see Trans. Ent. Soc. Lond., 1907, pp. 323, 330.

† See *Dixey*, Proc. Ent. Soc. Lond., 1898, p. xxxix.

‡ Including *Junonia*.

veloped, but in the other they are rudimentary or entirely absent. With the absence of ocelli is often associated a more angulated form of the wings, which are sometimes tailed, while the whole under surface is often of a redder colour, and the insect when at rest is cryptic, sometimes resembling a dead leaf. Again, in many Pierines there are also two forms, the one characterised by the black markings on the upper surface being more pronounced and sometimes by a suffusion or irroration of black scales; whereas in the other form there is an irroration of reddish scales on the under surface, with or without reddish or purplish markings.* Now these two forms have long been recognised as occurring for the most part in the Wet and Dry seasons respectively, though it must be admitted that in the case of *Terias* and *Catopsilia* the correspondence is not nearly so close as in *Mycalesis*, *Precis* and *Teracolus*. However, for convenience these are usually spoken of as "Wet-season forms" and "Dry-season forms," or even for shortness as "Wet" and "Dry."

When at rest, with wings closed above its back, the Dry-season insect is usually more cryptic than the Wet, resembling in some instances red soil, in others a dead or discoloured leaf. It is notable that the Dry-season form is commonly more marked in the female sex.

If among Neotropical butterflies similar pairs of forms are met with, I propose provisionally to speak of them as "Wet" and "Dry," and then to inquire to what extent they are found in the corresponding seasons of the year.

Calisto zangis, Fabr. (Jamaica). Although there is some variation in the size of the ocelli on the under side of the wings in my specimens, I am unable to divide them into seasonal forms.

Euptychia hermes, Fabr., *camerta*, Cram. In the Wet-

* In *Catopsilia*, *Callidryas* and *Ixias* the disco-cellular spots on the under side of both fore- and hind-wings are usually larger with larger white centres and altogether more conspicuous in the dry season. Moreover, in *Ixias* dry-season specimens have on the under side of the hind-wing a series of reddish, or purplish, post-discal spots, which when fully developed have white centres (especially in *I. pyrene*), and call to mind the similarly placed ocelli so well known in the *Wet*-season forms of *Mycalesis* and *Precis*, and indeed they are not unlike the rudimentary ocelli seen in "intermediate" specimens of those genera, though they never attain to the complicated "peacock-feather" pattern so characteristic of many *Nymphalidæ*.

season form the ground colour of the under-side is of a bluish-grey, the transverse lines are distinct and the ocelli well marked.

In the Dry-season form the ground colour is browner in tint, the transverse lines are faint and the ocelli are minute.

I give, in a tabular form, a statement of all the specimens that I took, divided into the three classes "Dry," "Wet," and "Intermediate." The specimens classed as intermediate I have attempted to divide according as they seem to approach nearer to one form or the other. Males and females are distinguished and the dates of capture given.

Euptychia hermes, Fabr., *camerta*, Cram.

PLACE.	DRY.	INTERMEDIATE.	WET.	DATE OF CAPTURE.
Trinidad . .	...	...	♂	19 Dec.
Panama . .	...	...	♂	28 Dec.
Venezuela .	♂ ♂ ♂ ♀ ♂	♂ ♀ ♂ ♂ ♂ ♀	♀	22–29 March.
Trinidad . .	...	...	♂ ♀	1 April
Tobago . .	...	...	♂ ♀ ♀ ♀ ♂	6, 7 April.
Trinidad . .	...	... ♂	♂	12 April.
Totals. .	4 ♂, 1 ♀	1 ♂, 1 ♀; 4 ♂, 1 ♀	6 ♂, 5 ♀	

It is somewhat remarkable that the specimens from Tobago were all distinctly "Wet" though the country showed every sign of extreme drought. Here the distinction between the forms might be local and not seasonal; or, as I am disposed to think, a seasonal form may have become localised.

Precis lavinia, Cram. The nomenclature of this species is in great confusion. Messrs. Godman and Salvin brought together the various forms found in Central America under the name *cœnia*, Hübn., including what is generally known in the West Indies as *genoveva*, Cram. Mr. Guy A. K. Marshall has recently rearranged the genus *Precis* in the National Collection, and I am happy to find myself in complete agreement with one whose knowledge of the genus is so intimate. Cramer figured three forms, all from Surinam; a ♂ which he called *lavinia*, a ♀ which he called *evarete*, and a ♀ which he called *genoveva*. The last two I agree with Mr. Marshall in considering to be Dry- and Wet-season forms respectively. The insect is

extremely variable, in ground colour, in the size of the ocelli on the upper surface (especially the anterior ocellus on the hind-wing), in the presence or absence of a greenish gloss, or "glance," and in the presence or absence of a transverse white band on the fore-wings (*zonalis*, Felder). In some specimens from Guiana this white band is replaced by a purplish gloss. It is almost impossible to divide these varieties into local races since the various forms overlap considerably, and the most widely different forms are found in Mexico. However, speaking generally, it may be said that the form *cænia*, Hübn., prevails in the United States and northern Mexico, that the form *zonalis*, Feld. (*genoveva*, auctorum) prevails in the West Indies (approaching to *cænia* in the Bahamas), that the type form *lavinia*, Cram., of which the ♂ has a hind-wing with a green gloss, prevails in Brazil, a brown form in Peru.

But what does not seem to have been generally noticed is that all the numerous varieties are themselves dimorphic. That is to say, that (as in the Indian species of *Precis*) they may be divided, as regards the colouring of the under surface of the hind-wings, into (1) those with several ocelli, of which two at least are conspicuous, (2) those in which the ocelli are merely indicated by black dots, or are entirely wanting, and (3) individuals intermediate in this respect. Analogy with the East would lead one to call the first *Wet-season* forms and the second *Dry-season* forms.

Precis lavinia, Cram.

PLACE.	DRY.	INTER-MEDIATE.	WET.	DATE OF CAPTURE.
Barbados	♀	...	♂	19 Dec. 1906.
Mt. Hope, Panama	...	...	♂	28 Dec. 1906.
Constant Spring, Jamaica . . .	...	♂	♂ ♀ ♀	31 Dec. 1906—8 Jan. 1907.
Mandeville, Jamaica	♂	...	...	20 Jan. 1907.
Port Antonio ,,	...	♂	♂	25 Feb. 1907.
Constant Spring, Jamaica . . .	♂	...	...	7 March 1907.
Panama City . .	♀ ♀	...	♀	12 March 1907.
Carácas, Venezuela	♂ ♂ ♂	...	♀	19–28 March 1907.
St. Ann's, Trinidad	...	♂	...	1 April 1907.
Tobago	♂	♂	...	6–8 April 1907.
Total . . .	7 ♂, 2 ♀	4 ♂	4 ♂, 4 ♀	

I brought home 21 specimens; of these 6 were taken between 18 Dec. and 8 Jan., 5 of them were "wet," only 1 "dry."

Fifteen were taken between 20 Jan. and 9 April; of these 8 were "dry," 3 "wet," and 4 intermediate.

As the dry season advanced the dry form more or less displaced the wet form.

Dated specimens in Mr. W. J. Kaye's collection taken in the wet season are mostly wet; the same applies to specimens in the Hope Collection. Judging from the condition of many of the specimens I met with, it is a long-lived insect and therefore considerable overlapping may be anticipated.

Anartia jatrophæ, Linn. Two forms are fairly well marked:—

Wet-season. Under side. Ground colour nearly white; markings often conspicuously edged with scarlet. Ocelli black with blue centres. No transverse bar on hind-wing.

Dry-season. Under side. Ground colour shaded with grey; markings edged with ochreous or reddish-brown, ocelli often blue only, orange-ringed. Hind-wing with a transverse grey bar.

Anartia jatrophæ, Linn.

PLACE.	DRY.	INTERMEDIATE.	WET.	DATE OF CAPTURE.
Trinidad . . .	...	...	♂	19 Dec.
Panama . . .	...	♀ ♀	♂ ♂ ♂	28 Dec.
Constant Spring	♀ ♀ ♀	♂ ♂	...	31 Dec.—5 Jan.
Mandeville . .	♂	♂ ♂	...	20, 21 Jan.
Mackfield . .	♂	♂	...	24 Jan.
Christiana . .	♂	...	...	16 Feb.
Port Antonio .	♀ ♀	♀ ♂	...	24 Feb.—4 Mar.
Panama . . .	...	...	♂	12 March.
Trinidad . . .	...	...	♂	1 April.
Tobago . . .	...	...	♂ ♂ ♂	4–5 April.
Total . . .	3 ♂, 5 ♀	3 ♂, 2 ♀; 3 ♂, 1 ♀	9 ♂	

The table would appear to point to the forms being local rather than seasonal. The "dry" specimens, it will be observed, were all taken in Jamaica and were all of the race, or sub-species *jamaicensis*, Möschler,* but, on the other hand, not all the *jamaicensis* were "dry."

* See "Butterflies taken in Jamaica," Trans. Ent. Soc. Lond., 1908, p. 44.

Callidryas eubule, Linn. The two forms are abundantly distinct, more especially in the male sex.

Dry form. ♂ *Under side.* Hind-wing, and all exposed part of fore-wing, irrorated with red-brown; the markings strong; stigmata clearly outlined.

♀ *Under side.* As in male but reddish irroration darker.

Wet form. ♂ *Under side.* No irroration: brown markings very faint; stigmata faintly outlined.

♀ *Under side.* Reddish irroration very faint.

Intermediate specimens are frequent, approaching now one, now the other form.

It may be at once admitted that these two forms of *C. eubule* are not restricted to the respective seasons to anything like the extent that is observed in the case, *e.g.*, of the S. African *Precis octavia*, Cram., and its "dry" form *P. sesamus*, Trim. Thus on 12 Jan., 1907, *C. eubule* was seen in numbers flying about a weedy field at Temple Hall, on the road between Constant Spring and Castleton, Jamaica. Three examples were secured; a female of well-marked "dry" and one of equally well-marked "wet" type, whereas the third, a male, may be described as "intermediate, inclining to wet." I was informed that there had been no rain for three weeks.

Callidryas eubule, L.

PLACE.	DRY.	INTERMEDIATE.	WET.	DATE OF CAPTURE.
Barbados	...	♀ ♀	♂ ♂	18 Dec. 1906.
Trinidad	...	...	♂	19 Dec. 1906.
Savanilla, Colombia	...	...	♂ ♂	22 Dec. 1906.
Cartagena ,,	...	♀	♂	23 Dec. 1906.
Colon, Panama . .	...	...	♂	28 Dec. 1906.
Constant Spring, Jamaica . . .	♀	♂ ♂ ♂	♂ ♀	1–9 Jan. 1907.
Castleton, Jamaica .	♀	♂ ♂	♀	11–12 Jan. 1907.
Mackfield ,,	♂ ♂ ♂ ♂	♀ ♀	...	25–27 Jan. 1907.
Montego Bay ,,	♂ ♀ ♀	♀ ♂	...	4–5 Feb. 1907.
Walderston ,,	♀ ♀	♀	♂	7–18 Feb. 1907.
Spanish Town,,	♀	...	♂	21–22 Feb. 1907.
Port Antonio ,,	♂ ♂	♂	...	3–5 Mar. 1907.
Constant Spring, Jamaica . . .	...	♀	...	7 Mar. 1907.
El Valle, Venezuela	...	♂ ♂ ♀	...	26–27 Mar. 1907.
Zigzag ,,	...	♂	...	29 Mar. 1907.
Tobago	...	♂ ♂ ♀ ♀ ♂ ♂ ♀	♂ ♂ ♀	3–10 Apr. 1907.
Totals . . .	7 ♂, 7 ♀	14 ♂, 12 ♀	12 ♂, 3 ♀	

It will be observed that (as we found in the case of *A. jatrophæ*) no distinctly "dry" specimens were taken out of Jamaica. There is also evidence (very ambiguous in the case of Tobago) that the "dry" form tended to displace the "wet" as the season advanced.

I had also the advantage of examining Mr. W. J. Kaye's series of this insect. Of six specimens taken in Jamaica in the month of August (wet season) 5 are of the "wet" form, 1 of the "dry." Of two specimens taken in Trinidad in July, one is "wet," the other "intermediate," another taken in September is also "intermediate." A specimen taken in British Guiana in either November or December is "wet."

These facts are fairly in accord with the theory that the dimorphism is seasonal in the case of *C. eubule*, especially if due allowance be made for the fact that the insect has the appearance of being long-lived.

Terias euterpe, Mén. (Jamaica). My 60 specimens exhibit but very trifling differences that can be set down to possible seasonal dimorphism.

The specimens that I am disposed to regard as exhibiting Dry-season coloration may be distinguished by the following characters on the *under surface.*

The reddish-orange edging of the wings is more conspicuous. The hind-wings are irrorated with purplish-brown scales, and the purplish markings (especially the borders of the apical pink patch) are more conspicuous.

I do not give the results as set out in the following table with much confidence, and the division of the "intermediate" specimens into those inclining rather to wet or to dry respectively should not carry much weight. Subject to these limitations, it will be seen that the specimens considered as "wet" were commonest at the two extremities of the period, those considered as "dry" prevailed throughout the first half of February.

Terias euterpe, Mén. (Jamaica).

PLACE.	DRY.	INTERMEDIATE.	WET.	DATE OF CAPTURE.
Constant Spring	♂ ♂	♂ ♀ ♂	♂ ♂ ♂ ♀	31 Dec.—4 Jan.
,, ,,	...	♂ ♀	♂	8–10 Jan.
Castleton . .	♀	♂ ♂	♀ ♂	11–12 Jan.
Mandeville . .	♂ ♀ ♀ ♂	♂ ♂ ♂	...	17–22 Jan.
Mackfield . .	♂ ♀	♂ ♀ ♀ ♂ ♂ ♂ ♂ ♂	♀ ♂	24–27 Jan.
,, . .	♀	♂ ♀ ♀ ♀ ♂ ♂ ♂	...	29 Jan.—2 Feb.
Montego Bay .	...	♀	...	4 Feb.
Walderston . .	...	♂ ♀ ♂	...	8–14 Feb.
Christiana . .	♂	♂ ♂	...	16 Feb.
Walderston . .	♀	♀ ♂ ♀	♀	18 Feb.
Port Antonio .	...	♂ ♀ ♂	...	25 Feb.—1 Mar.
Constant Spring	...	...	♂	7 March.
Total . . .	6 ♂, 6 ♀	20 ♂, 10 ♀; 5 ♂, 2 ♀	7 ♂, 4 ♀	

Terias delia, Cram. (Jamaica, N. Coast of S. America).

The extreme "seasonal" forms are quite distinct.

♂ Upper side.

Wet-season.

Ground pale yellow; costa broadly black; longitudinal black stripe broad.

Dry-season.

Ground full yellow; costa faintly grey; longitudinal black stripe narrower.

♂ Under side.

Wet-season.

Uniformly white.

Dry-season.

Hind-wings and costal three-fourths of fore-wings yellow irrorated with brown.

♀ Upper side.

Wet-season.

Ground white; costa broadly grey.

Dry-season.

Ground of fore-wing pale yellow extending to costa.

♀ Under side.

Wet-season.

Fore-wing white; border pale yellow; hind-wing pale yellow irrorated with grey.

Dry-season.

Fore-wing yellow, its tip and all hind-wing pinkish-orange irrorated with darker.

Terias delia, Cram.

PLACE.	DRY.	INTERMEDIATE.	WET.	DATE OF CAPTURE.
Savanilla, Colombia	...	♀	♂	22 Dec. *F. lydia.*
Colon, Panama . .	...	...	♂ ♂ ♂ ♂ ♀	28, 29 Dec. *F. lydia.*
Constant Spring, Jamaica . . .	♂ ♂ ♀ ♀ ♂	♂ ♂ ♂ ♀ ♂	♂ ♂ ♂	1–8 Jan.
Castleton, Jamaica	...	♀	♂	12 Jan.
Mandeville ,,	♀	♂	...	22 Jan.
Mackfield ,,	♀ ♀ ♀ ♂ ♀	♂	♂	24–26 Jan.
Montego Bay, Jamaica . . .	♀	...	♀	4 Feb.
Walderston, Jamaica	♀ ♂	...	...	12 Feb.
Port Antonio, Jamaica . . .	...	♀	...	25 Feb.
Constant Spring, Jamaica . . .	♀	...	...	7 March.
Ancon, Panama .	♀ ♀ ♀	♂ ♂	...	11, 12 Mar.
Savanilla, Colombia	♀	...	...	15 March.
Carácas, Venezuela	♀ ♀	...	...	18–25 Mar.
Total	5 ♂, 16 ♀	8 ♂, 3 ♀; 1 ♀	10 ♂, 2 ♀	

An examination of this table shows clearly that the dry form got more prevalent as the season advanced, whereas the wet form disappeared. All the first 7 specimens, taken at Savanilla and Colon, 22–29 Dec., are of the form *lydia*, Felder. The last specimen taken, at Carácas, 25 March, is of the form *persistens*, Butl.

A male taken above Constant Spring, *c.* 1000 ft., on 1 Jan., another male taken a little to the west of Constant Spring, *c.* 500 ft., on 8 Jan., and a male taken near the railway at Panama on 12 March, all approach the form *lydia*, Felder, in having the longitudinal black streak broader than usual. On the other hand, the width of the streak in the form *lydia* varies considerably.

An aberrant male of the dry form taken on the foothills above Constant Spring on 1 Jan. is entirely without the black streak, the orange scales alone marking its position.

Terias elathea, Cramer (Jamaica, Venezuela), appears to be specifically distinct from *delia*, but is certainly very closely allied to it; the females are difficult to distinguish, and some specimens of the male sex not easily separable.

What I take to be the Wet form has the under side irrorated with grey; the Dry form with reddish.

Terias elathea, Cram.

PLACE.	DRY.	INTER-MEDIATE.	WET.	DATE OF CAPTURE.
Constant Spring, Jamaica	♀ ?	...	♂	1, 2 Jan.
Montego Bay ,,	...	♂	...	3 Feb.
Port Antonio ,,	...	...	♂	3 March.
Carácas, Venezuela . .	...	♂ ♂	...	18–20 March.
Total	1 ♀	3 ♂	2 ♂	

In one of the Carácas specimens the black streak is very faint and might be described as obsolescent, in the other there is no trace of the black streak and scarcely any orange.

It will be observed that this aberration was in both species met with in dry, or somewhat dry specimens, but I scarcely think that it can be considered as the extreme dry form, at all events without more material.

Pieris phileta, Fabr., Jamaica, Venezuela, Tobago. In this species the seasonal differences are well known.

Wet-season form. Under side. Wings white, with but faint traces of yellow.

Dry-season form. Under side. Hind-wing and tip of fore-wing yellow; veins and lines in interspaces brown.

Pieris phileta, Fabr.

PLACE.	DRY.	INTER-MEDIATE.	WET.	DATE OF CAPTURE.
Montego Bay, Jamaica .	♂	...	...	4 Feb.
,, ...	...	♂	...	5 Feb.
,, ...	♀	...	...	,,
Walderston, Jamaica . .	♂	...	...	7 Feb.
,, ...	...	♂	...	,,
Venezuela	...	...	♂	30 March.
,, ...	...	...	♂	,,
Tobago	...	♂	...	10 April.
,, ...	...	...	♂	,,
Total	2 ♂, 1 ♀	3 ♂	3 ♂	

Here again the forms seem to depend on locality more than season.

In case any one should desire to examine more closely into the matter I append notes on the weather conditions during the period in which I was collecting.

West Indies, etc., Meteorological Notes.

18 Dec.	*Barbados.* End of Rainy Season: a shower that morning early. Much rain in November. "Christmas Winds" prevailing.
19 Dec.	*Trinidad.* "Much rain lately": very wet season: rain that morning; ground wet.
20 Dec.	*La Guaira.* Muddy streets and the appearance of much recent rain.
22 Dec.	*Savanilla.* Woods very dry: run-to-seed.
23 Dec.	*Cartagena.* A dry burnt-up look.
27 Dec.	*Porto Bello.* Rain all day: also rain the day before.
28 Dec.	*Colon.* Heavy shower this morning. Very heavy rain reported November and early December.
31 Dec.	*Constant Spring.* No rain for three weeks: unusually cold at Christmas. Country very dry and run-to-seed.
7 Jan.	*Constant Spring.* A smart shower.
15–16 Jan.	„ „ Trifling shower in the night.
16 Jan.	*Mandeville.* No rain for eight weeks: vegetation very dry.
19 Jan.	*Mandeville.* Several showers: cloud most days.
21–22 Jan.	*Mandeville.* Some rain in the night.
24 Jan.	*Mackfield.* Reported to have been an exceptionally wet season: heavy rains November and up to 12 Dec.; nothing but trifling rain since; vegetation and soil very dry.
25 Jan.	*Mackfield.* Rain afternoon and evening.
29 Jan.	„ Rain in early morning.
31 Jan.	„ Two heavy showers this afternoon.
2 Feb.	*Montego Bay.* Heavy showers about four or five days before our arrival: before then no rain for a fortnight.
7 Feb.	*Walderston.* No rain since 13 November, except trifling showers 3 Feb.
11 Feb.	*Walderston.* Rain at dusk and early evening.
12 Feb.	„ Rain afternoon and evening.

13 Feb. *Walderston.* Wind and drizzle.
15 Feb. „ Slight rain in afternoon.
16 Feb. „ Heavy shower in afternoon.
20–23 Feb. *Spanish Town.* Rain while we were there and several showers the previous week.
24 Feb. *Port Antonio.* "No rain in January: some last week." Another informant, "Very dry up to the time of the earthquake (14 Jan.), frequent showers since."
24 Feb.–5 Mar. *Port Antonio.* Rained nearly every day or night of our stay. Heavy rain 27 Feb.
7 March. *Constant Spring.* "A good rain eight days ago, and other showers since the earthquake (14 Jan.)"; nevertheless everything looked very dry.
11 March. *Panama.* Country very dry.
20 March. *Carácas.* I was informed "last year was very wet, up to 25 Jan.; since then it has been our dry season, though there was some rain last week."
21 March. *Carácas.* Heavy shower late afternoon.
22 March. „ Very heavy rain mid-day and afternoon.
23 March. *Carácas.* Heavy rain mid-day and afternoon—many hours.
29 March. *La Guaira.* The road down showed traces of heavy rain within a few days.
4 April. *Tobago.* Everything very dry, but was informed that there had been "some nice showers at night during March."
8 April. *Tobago.* Very heavy showers.
12 April. *Trinidad.* Heavy rain.
14 April. „ A shower.

For assistance in the preparation of this paper I am more especially indebted to Prof. E. B. Poulton, F.R.S., to Dr. F. A. Dixey, to Mr. Guy A. K. Marshall, to Commander J. J. Walker, R.N., M.A., and to Mr. W. J. Kaye, but the valuable services of Messrs. Holland, Hamm, and Collins, assistants in the Hope Department, Oxford, must not be overlooked, while I have to thank Mr. Horace Knight for his skill in interpreting my rough sketches.

January 20, 1909.

THE

PROCEEDINGS

OF THE

ENTOMOLOGICAL SOCIETY

OF

LONDON

FOR THE YEAR 1908.

Wednesday, February 5th, 1908.

Mr. C. O. WATERHOUSE, President, in the Chair.

Nomination of Vice-Presidents.

The PRESIDENT announced that he had nominated Dr. THOMAS ALGERNON CHAPMAN, M.D., F.Z.S., Professor RAPHAEL MELDOLA, F.R.S., F.C.S., and Mr. HENRY ROWLAND-BROWN, M.A., as Vice-Presidents for the Session 1908–9.

Election of a Member of the Council.

The PRESIDENT announced that the Council had elected Mr. JAMES WILLIAM TUTT to serve as a member of the Council in the place of the late Mr. ARTHUR JOHN CHITTY, deceased.

Election of a Fellow.

Mr. C. GORDON HEWITT, M.Sc., of the University, Manchester, was elected a Fellow of the Society.

Exhibitions.

BUTTERFLIES FROM THE PYRENEES.—Dr. T. A. CHAPMAN exhibited a collection of butterflies made last summer at Gavarnie in the Pyrenees, including a number of specimens of *Erebia lefebvrei*, with *E. melas* from South-east Hungary, for

comparison. He pointed out, and illustrated by means of enlarged photographs the superficial differences in the wing-markings between the two species, and also drew attention to the fact that specimens of *Lycæna orbitulus* taken on the Simplon, Switzerland, are identical with *L. orbitulus*, var. *oberthüri* of the Pyrenees.

Ants from Kew Gardens.—Mr. H. St. John Donisthorpe showed eleven species of ants taken in the hothouses in Kew Gardens in December 1907 and January 1908, eight † being new to the published Kew list, and six * species not before recorded as introduced in Britain. The species were:—

Prenolepis longicornis, Latr. ♀ ♀ and ☿ ☿.
† *Tetramorium simillimum*, Smith. ☿ ☿.
Technomyrmex albipes, Smith. ♂, ergatoid ♂ and ☿ ☿.
* † *Wasmannia auro-punctata*, Roger. ♂, ♀ ♀ and ☿ ☿.
Triglyphothrix striatidens, Emery. ☿ ☿.
* † *Prenolepis flavipes*, Smith. ♂, ♀ ♀ and ☿ ☿.
* † *Plagiolepis alluaudi*, Forel. ☿ ☿.
* † *Prenolepis cæciliæ*, Forel. ☿ ☿.
† *P. vividula*, Nyl. ☿ ☿.
* † *Strumigenys rogeri*, Emery. ☿ ☿.
* † *Ponera punctatissima*, sub. sp. *boerorum*, Forel. ♀ and ☿ ☿.

All found in numbers, except the *Ponera* and the *Strumigenys*.

Potato Gnat in Britain.—Mr. J. E. Collin exhibited microscopically-mounted specimens of a minute species of Diptera belonging to the family *Mycetophilidæ*, and closely related to the genus *Sciara* which Mr. H. J. Charbonnier had discovered attacking and doing considerable damage to narcissus bulbs in the neighbourhood of Bristol in 1907. The species, which was remarkable inasmuch as while the male had abbreviated wings the female had neither wings nor halteres (an exceedingly rare structural condition in the Diptera), had been described under the name of *Epidapus scabiei* in the Proceedings of the Entomological Society of Washington, U.S.A., published in 1895 by Mr. A. D. Hopkins, of the West Virginia Experiment Station, who found it attacking potato tubers and causing conditions which in one

stage would be recognised as potato-scab, and in a more advanced stage as potato-rot. Mr. Collin gave a short *résumé* of Mr. Hopkins' experiments and observations, and remarked that though at present there was no record of the species doing any damage to the British potato crop, still its occurrence in England was of considerable economic importance.

Larvæ of Sitaris muralis.—Commander J. J. Walker showed on behalf of Mr. A. H. Hamm, very young larvæ of *Sitaris muralis*, hatched at end of October and beginning of November from ova laid by ♀ ♀s in captivity (the natural place of deposit of these eggs being at the entrance to the burrow of the bee, *Anthophora pilipes*, in stone walls near Oxford). Hitherto the larvæ had kept together on the mass of empty egg-shells.

Pyralis lienigialis at Oxford. — Commander Walker also exhibited two specimens of the rare *Pyralis lienigialis*, Zell, ♀, taken at light in his house at Summertown, August 1906 and 1907.

South American Thynnidæ.—Mr. Rowland E. Turner brought for exhibition a box of *Thynnidæ* from S. America, mostly from Chile, several of the species having been captured *in copula*. The mouth parts in the females of the S. American species are not reduced in size and almost rudimentary, as with almost all the Australian species of the family. As is the case in Australia the species become less numerous in the Tropics, and in the northern half of S. America seem to be confined to the highlands. Several new species were shown from Mendoza and the Peruvian Andes.

The Mandibles of Trachyphlœus scabriculus.—Prof. T. Hudson Beare exhibited a specimen of *Trachyphlœus scabriculus* with the two deciduous mandibles still in place. The specimen was taken at St. Margaret's Bay in August 1907; it was found at the roots of grass on the cliffs.

Suggested Mimicry in Bourbon Butterflies.—Lieut.-Colonel Manders exhibited the ♀ of *Papilio phorbanta* from Bourbon, an aberrant member of the *niveus* group of Papilios, and compared it with the other members of the same group from the African mainland, Madagascar and Mauritius, kindly lent for the purpose by Professor Poulton. He pointed out

that whereas in all the other species the ♀ ♀s were some shade of green similar to the ♂ ♂s, the Bourbon insect was more or less uniformly brown. He suggested that this was due to mimicry, *Euplœa goudoti*, a species strictly confined to Bourbon, being the model. The case had been dealt with more fully and the insects figured in his paper on "The butterflies of Mauritius and Bourbon," in the Transactions 1907.

Mimicry in the Butterflies of Mauritius and Bourbon.—Professor E. B. Poulton, F.R.S., exhibited a series of species of the *Papilio nireus* group from many parts of Africa, from Madagascar, Mauritius and Bourbon, together with other Rhopalocera from the two latter islands bearing on the subject of mimicry. He said that his attention had been directed to the difficult and fascinating problems presented by these small outlying islands by the recent interesting observations and experiments of Colonel N. Manders, to whose kindness he owed the opportunity of exhibiting some of the specimens.

The black blue-marked upper-surface of the wings in the numerous species and sub-species of the *Papilio nireus* group presented a singularly uniform and characteristic appearance throughout Africa and Madagascar. It appeared probable to the speaker that these forms constituted a definite Ethiopian synaposematic group. One of the species (*epiphorbas*, Boisd.) in Madagascar had, however, spread into Mauritius as *Papilio manlius*, F., and into Bourbon as *P. phorbanta*, L. (*disparilis*, Boisd.). These two island-forms were entirely separated geographically from other members of their abundant and dominant group, while they at the same time came into contact with *Euplœas* of a characteristic Oriental type of colouring, with *E. euphone*, F., in Mauritius, with *E. goudoti*, Boisd., in Bourbon. Under these circumstances the dark ground-colour of the female *Papilio* in Mauritius has faded to a brown shade not unlike that of the *Euplœa*, while the blue markings have lost their sharp outlines and have become slightly reduced in size as compared with those of the male. The mimicry is, of course, in a very incipient stage—so incipient, indeed, as to be probably unrecognisable were it not for the far more complete resemblance attained by the female of *phorbanta* in Bourbon. With this latter female

before us it is impossible to doubt the significance of the differences which separate the female of *manlius* from its male. In the female of *phorbanta* the central blue patches have entirely disappeared, while the blue submarginal spots of the hind-wing have become increased in size and transformed into white. Furthermore, the ancestral submarginal band of blue spots in the fore-wing has also been transformed into white. These changes, with the exception of that last mentioned, produce a rough mimetic likeness to *Euplœa goudoti*, as may be seen in Colonel Manders' beautiful plate (Trans. Ent. Soc. Lond., 1907, Pl. xxix, figs. 6a and 1). It is evident from Colonel Manders' account (l. c., p. 451) that the resemblance which appears to be so slight in the cabinet is much enhanced by the mode of flight, and the fact that *Papilio* and *Euplœa* inhabit the same localities. Nevertheless it is impossible to be satisfied with the simple conclusion that the female *phorbanta* has gained its present pattern under the sole influence of *Euplœa goudoti* as we now know it in Bourbon.

The ancestral submarginal blue spots of the hind-wing of the male *phorbanta* are already somewhat larger than the white spots occupying a similar position in *Euplœa goudoti*. The blue spots transformed to white cannot therefore have undergone a further increase in size in the female under the influence of the existing *Euplœa*. Nor is it possible to account by the same influence for the submarginal white spots of the fore-wing of *phorbanta*; for Colonel Manders (l. c., p. 435) only knows of a single specimen of *goudoti* "with faint but decided indications of a submarginal row" in the fore-wing. It is obvious that the present pattern of the Bourbon *Euplœa* cannot afford us the interpretation of the change which has occurred in the female *Papilio*.

If the upper-surface pattern of the female *phorbanta*, fig. 6a, on Colonel Manders' plate, be compared with that of *Salamis augustina*, fig. 3, and *Euplœa goudoti*, fig. 1, it will at once be seen that the *Papilio* bears a far closer resemblance to the Nymphaline than to the Euplœine. Now the upper-surface of the *Salamis* is a fair mimic of the Mauritian *Euplœa euphone*, as was pointed out by Mr. Roland Trimen, F.R.S., in 1866:—"In spite of the very different outline of wings, the general

coloration of this butterfly bears considerable resemblance to that of *Euplœa euphone*, and I can well imagine its escaping notice if flying in company with the latter species" (Trans. Ent. Soc. Lond., 1866, p. 335).

We are therefore led to the conclusion that *phorbanta* has also been influenced by *euphone*. The situation is thus extremely puzzling, the female *Papilio* being a far better mimic of the Mauritian *Euplœa* than of the species with which it flies in the island of Bourbon. There can be little doubt that the Mauritian *euphone* presents a more ancestral pattern than *goudoti*. The *Euplœa* mimics of both islands are always mimetic of *euphone*: they never attain the features by which *goudoti* is distinguished from *euphone*. This is not only true of the *Papilio* and *Salamis*, but also of the Mauritian *Amauris* (*Berethis*) *phædone*, F. Concerning this latter species Mr. Roland Trimen, F.R.S., observed in 1866 that "its peculiar facies and colouring give it a strong superficial resemblance to *Euplœa euphone*" (Trans. Ent. Soc. Lond., 1866, p. 332). He furthermore states that he "found *D. phædone* much scarcer than *E. euphone*, but almost invariably flying in company with the latter." * Inasmuch as these mimetic resemblances to *euphone* cannot have been attained except in the course of a long period of time, the pattern of this *Euplœa* must be ancient as compared with that of *E. goudoti*, which has produced no apparent effect on its own account.

Furthermore, it must be pointed out that the upper-surface pattern of the unique and remarkable *Libythea cinyras*, Trim., is probably roughly mimetic of *Neptis frobenia*.

We have been accustomed to look upon islands as the homes of the non-mimetic ancestors of mimetic species; but Mauritius and Bourbon prove that an exceptional development of mimicry may be found among the members of small communities confined in very restricted areas. It has been already stated that the mimicry of the female *phorbanta* is unique in the *nireus* group. If I am right in supposing

* So far as I have had the opportunity of examining it *phædone* seems to be related to *Amauris albimaculata*, Butl., rather than to *A. echeria*, Stoll. Dr. Karl Jordan whom I have consulted on the point kindly informs me that he agrees with the above conclusion as to the affinity of *phædone*.

Libythea cinyras to be a mimic, it too is a unique example in its group. *Salamis augustina* is also a nearly equally rare instance in the genus.

A fascinating aspect of the mimicry in these islands is to be found in the extraordinary effect of one of the most dominant and distasteful types of the Oriental Region upon characteristic Ethiopian forms. Ethiopian species of *Amauris*, *Salamis* and *Papilio* all exhibit the influence of *Euplœa*. It is most unfortunate that the question was not studied many years ago when the aspect of the country and the indigenous fauna were comparatively unchanged. As Colonel Manders suggests, we might then, in all probability, have attained to a precise knowledge of the selective forces by which the approach has been brought about.

In conclusion, Professor Poulton desired again to thank Colonel Manders for directing the attention of the Society to the deeply interesting problems presented by the faunas of these two islands; and personally he wished to thank him for much kind help both in information and material. He had also been greatly indebted to Mr. Roland Trimen, F.R.S., with whom he had discussed the whole question, and from whom he had received many valuable suggestions.

Secondary Mimetic Resemblance of Ithomiinæ to the Danaine genus Ituna.—Professor E. B. Poulton said that he was indebted to the kindness of Mr. W. J. Kaye, F.E.S., for the opportunity of exhibiting what seemed to him a very interesting example of secondary mimicry. In 1898 he had described and figured in the Zoological Journal of the Linnæan Society (Vol. xxvi, p. 558) the great combination of South American Lepidoptera which is ranged round the two chief models *Methona confusa*, Butl., and *Thyridia psidii*, L. The combination included numbers of *Ithomiinæ* belonging to several genera, two species of *Ituna* (*Danainæ*), one of *Pierinæ*, and many Heterocera belonging to the *Castniidæ* and *Pericopidæ* (*Hypsidæ*). At the time when that paper was written he had no conception of the predominance of secondary resemblances between mimics, and had naturally failed to find what he never looked for. However, a few weeks ago he saw in Mr. Kaye's collection the specimens now being exhibited, and at

once realised that the Ithomiine *Eutresis imitatrix*, Staud., is an exceedingly good secondary mimic of *Ituna* itself, the historic mimic of *Thyridia* (and *Methona*) upon which Fritz Müller based his theory. Reference to the Linnæan Society plate published in 1898 showed that nearly all the points of secondary resemblance are clearly displayed, although they had never been recognised. It was almost humiliating to realise the dependence of observation on hypothesis.

After recognising this interesting example of secondary mimicry in Mr. Kaye's collection, the fine series in the British Museum, including, in these groups, the Godman-Salvin material, was carefully studied with Mr. G. A. K. Marshall's kind assistance. In the course of the examination certain features of the primary Ithomiine models, *Methona confusa* and *Thyridia psidii*, were compared and the conclusion reached that, as regards these points, the *Methona* has acted as model and the *Thyridia* as mimic. The whole of the conclusions arrived at are embodied in the following account.

The general appearance of *Eutresis imitatrix* is far more that of *Ituna phenarete*, D. & H., than of *I. ilione*, Cram. The latter is a smaller, more intensely and heavily black-marked, yellower and less transparent insect than *phenarete* and its Ithomiine mimic.

The black-shafted, yellow- or orange-clubbed antennæ form one of the most conspicuous features of the *Methona-Thyridia*-centred combination, and one in which mimetic resemblance is very obvious. It is therefore of great interest to compare the colouring of the antennæ in species of *Ituna* and *Eutresis* with each other and with the *Methona* and *Thyridia*.

Ituna lamirus, Latr. The antennæ are yellow, darkened at the extreme base. This darkening extends throughout the basal half in a male specimen from the interior of Colombia, and still farther in a male from the Rio Napo. These are the only exceptions in the series of 41 specimens of *I. lamirus* in the British Museum.

Ituna ilione. The antennæ resemble those of the primary Ithomiine models: *Methona confusa* and *Thyridia psidii*, being intensely black with an orange club.

Ituna phenarete. The club of the antenna is much longer

and of a paler colour than in *ilione*. It also tapers more gradually into the shaft on to which the yellow tint is often prolonged, generally for a short distance, occasionally as far as in *I. lamirus*.

Eutresis imitatrix and an allied unnamed species. The antennæ resemble the appearance most usual in *I. phenarete*, but the depth of the orange tint is as in *I. ilione*. A similar appearance is presented by the females and 2 males of *Eutresis hyspa*, Godm. and Salv.

Eutresis other species. The antennæ of 4 males of *E. hyspa* and of all the remaining species of the genus are similar to those of *I. lamirus*.

Hence as regards this prominent feature, the brownish translucent *Ituna lamirus* resembles the similarly coloured species of *Eutresis*; the transparent black-marked species of *Eutresis* (*imitatrix*, etc.) resemble the transparent and black *I. phenarete*; while *Ituna ilione* resembles the primary Ithomiine models.

The remaining points of comparison are confined to elements in the pattern of the upper surface of the fore-wing.

All the species of *Eutresis* in the British Museum, except *E. imitatrix*, a single specimen of an allied unnamed form, and certain individuals of *E. hyspa*, possess, on the fore-wing upper-surface a submarginal row of six internervular pale yellowish spots, somewhat more yellow and less transparent than the large transparent areas of the wing. In *E. imitatrix* and the undescribed form, the four submarginal spots nearest the apex, although still traceable by change of tint and degree of transparency, fuse with and become part of the large apical transparent area. The same tendency, although less marked, is seen in *Eutresis hyspa*, especially in two females from Ecuador. In the above-mentioned three forms the black band which in other species cuts off the four apical spots from the transparent area, becomes very indistinct, and resembles a faint cloudy dark bar which in the transparent *Itunas* also cuts off a more opaque yellower distal section of the apical area. Comparing these Itunas (*ilione* and *phenarete*) with the less transparent *I. lamirus*, Latr., it is seen that the faint cloudy bar corresponds to the black ground-colour which

separates a row of three subapical spots from a more centrally placed row of four spots, of which the lowest and outermost approaches the margin, reaching the position of the fourth submarginal spot of *Eutresis*. In some individuals this outermost spot also exhibits faint traces of increased yellowness and opacity at its outer and lower extremity.

The fifth and sixth submarginal spots of the fore-wing of *Eutresis imitatrix*, the allied form, and *E. hyspa*, as regards their black internal contours, resemble *Ituna ilione* more closely, as regards their transparency.—*I. phenarete.*

The black transverse bar which descends from the costa of the fore-wing and crosses the cell, forms nearly a right angle with the costa in *Methona confusa*, while in the transparent Ecuador form *psamathe*, Godm. and Salv., it is sometimes rather less than a right angle on the basal side, rather more on the distal. In *Thyridia psidii* the bar is always obliquely directed, forming an acute angle with the costa on the distal side. In *Ituna phenarete* and *Eutresis imitatrix* it is still more oblique and the distal angle even more acute. Of more importance is the direction of the bar, which is almost straight in the *Methona* and the *Thyridia*, but turns inwards at or sometimes below the point at which the first median nervule leaves the median nervure, in *I. phenarete* and *E. imitatrix*. The elbow is rendered prominent by an extension of the black marking on the convexity of the bend. As regards this feature *I. ilione* has apparently been drawn towards the primary Ithomiine models; for the elbow is far less marked than in *phenarete*.

Furthermore, in both species of *Ituna* and in *Eutresis imitatrix*, a small triangular portion is cut off by the median nervure from the outer and lower part of the basal transparent area. In *Methona confusa*, on the other hand, the broad black inner margin reaches the median nervure, and obliterates this part of the basal area. In *Thyridia psidii* a more or less distinct trace of transparency nearly always persists in this region below the nervure, although the condition of *Ituna* and *Eutresis* is apparently never equalled.

As regards the two primary models it is evident that in this last-mentioned feature the *Methona* has been mimicked

by the *Thyridia* ; for the species allied to the former,—*Methona themisto*, Hübn., and *M. singularis*, Staud.,—resemble *M. confusa*; while in the Thyridias allied to *psidii*,—*pallida*, Godm. and Salv., *ceto*, Feld., and *œdesia*, D. & H.,—a comparatively large section of the pale basal area is visible below the nervure. *Thyridia hippodamia*, F., presents a condition similar to that of *T. psidii*.

There is also a tendency in the Itunas and especially in *Eutresis imitatrix*, for the median transparent area to be nearly equally divided by the black and prominent vein which traverses it. This tendency is less marked in the *Thyridia*, and still less in the *Methona*; and here too the latter has apparently acted as the model for the former ; inasmuch as in the allied *Thyridia œdesia*, the area in question is divided by a heavily marked band.

Finally, the facts of geographical distribution entirely support the conclusion that the transparent species of *Eutresis* are mimics of *Ituna phenarete* and not of *I. ilione*. The latter is an eastern and southern species : of 16 examples in the British Museum, 2 are from Rio, 2 from Minas Geraës, 3 from Brazil, 2 from S. Brazil, and 7 from Paraguay. *I. phenarete*, on the other hand, is a western species : of 15 examples, 10 are from Bolivia, 3 from Peru, 1 from Ecuador and 1 from Tabatinga (Amazons). The three examples of *Eutresis imitatrix* and all of *E. hyspa* are from Ecuador, while the single undescribed form is from Peru.

Papilios from the Malay Archipelago.—Dr. K. Jordan exhibited on behalf of the Hon. Walter Rothschild some interesting Papilionids. *Troides alexandræ*, Rothsch., remarkable for the beauty of the ♂ and the gigantic size of the ♀, is a new discovery by A. S. Meek, who found this fine insect in the north-eastern portion of British New Guinea at some distance inland from the coast. The species is nearest to *Troides victoriæ* from the Solomon Islands, of which a very distinct geographical form (*rubianus*) was shown for comparison. The gynandromorphic specimen of *Troides* exhibited is the only one known of this genus, and was obtained by Dr. L. Martin in South Celebes. It belongs to *T. haliphron*, the left side being ♀ and the right side ♂.

Tortrix pronubana in Britain continuously brooded.—Mr. R. Adkin exhibited specimens of *Tortrix pronubana*, Hb., reared in June and July from larvæ collected in May, also others reared in autumn from ova deposited by moths of the June emergence. He said that of the larvæ derived from the June emergence the majority produced moths in the autumn, but a portion of them hybernated when nearly if not quite full fed, and that the larvæ derived from the autumn moths hybernated quite small. He therefore concluded that when the habits of the species came to be better understood, it would be found, as had been shown to be the case in Guernsey, to be practically continuously brooded in this country throughout the summer months, the chief emergences taking place in June and October, but with stragglers appearing probably in every month from April to November.

Mr. J. W. Tutt remarked that in the south of France it was common in March and April, at Digne and Draguignan. Millière says it is single brooded.

Variation in Melitæa aurinia and Notodonta chaonia.—Mr. L. W. Newman showed (*a*) a long series of *Melitæa aurinia* bred from ova from West Meath parents, the ♀ parents being very rich dark forms; the offspring followed the ♀ parents to a great extent, being rich dark forms, a small percentage being somewhat lighter in ground-colour—(= *hibernica*, Birchall); (*b*) a series from East Kent of the usual Kentish form, the specimens showing a wide range of variation. Owing to the great lack of sunshine in May 1907, the pupal stage lasted four weeks instead of ten days or so, during which a large percentage died; (*c*) a series bred from a S. Devon typical ♀: very ordinary forms and a very large percentage of deaths in the pupal stage owing to cold and lack of sunshine; (*d*) a series from S. Wales, wild collected larvæ; received full-fed at end of March, and being abnormally early, emerged very well, as all were out before the bad weather began: very little variation disclosed; (*e*) a series from Carlisle, wild collected larvæ. These larvæ were fearfully ichneumoned, over 75 % being stung and a very short series was bred, giving no idea of the range of variation; (*f*) a series from Isle of Wight, wild collected larvæ. Unlike the

Carlisle larvæ, not one of these was ichneumoned, and were very forward, being three-quarters fed when received end of March. All emerged well, but the quantity at disposal being small, most were spoilt in obtaining pairings and ova.

Mr. Newman also exhibited (*g*) a long series of *Notodonta chaonia* bred from ova from Perth parents, both of the typical dark brown form. The series showed a great range of variation, a good percentage following the parents; a large percentage of intermediate forms, and about 15 % with the white band on fore-wings well defined; (*h*) a series from New Forest parents, this form showing a strong contrast to the Perth race, the ground-colour being much whiter and the white on fore-wings much pronounced, bringing out the lunar spot conspicuously; (*i*) a series from a pairing obtained from Perth ♀ and New Forest ♂, the experiment producing a very mixed series, the general tendency being to follow the dark Perth ♀ parent: very few (three or four) being as light as the ♂ parent; (*k*) a series from an Isle of Wight wild captured ♀, this form being quite distinct from that of the New Forest, having a yellowish tinge, and the ground-colour being about intermediate between the darkest Perth and lightest New Forest forms.

Mimetic Relation of Nychitona and Pseudopontia.—Dr. F. A. Dixey exhibited specimens of *Nychitona medusa*, Cram., and *Pseudopontia paradoxa*, Feld., observing that a former suggestion of his as to a mimetic relation between them (see Proc. Ent. Soc. Lond., 1906, pp. lxix–lxxi) had been confirmed by a letter lately received from Mr. S. A. Neave, at present in the Congo State, who wrote that the two forms "inhabit exactly the same localities and are barely distinguishable from each other on the wing."

Papers.

Mr. Rowland E. Turner communicated a paper "On Two Diplopterous Hymenoptera from Queensland," and "Notes on Thynnidæ, with remarks on some aberrant genera of the Scoliidæ."

Mr. Guy A. K. Marshall read a paper entitled "On Diaposematism, with reference to some Limitations of the

Müllerian Hypothesis of Mimicry." In this he pointed out the difficulty of accepting the idea of a mutual simultaneous mimicry between two unpalatable species, such as is postulated by the hypothesis of Diaposematism. It was suggested that an initial inequality in the individual numbers of the two distasteful species was an essential condition for the production of Müllerian mimicry, and that in such circumstances the mimetic approach would always be in one direction only, namely, from the rarer species towards the more abundant; for any initial variation from the latter towards the former must be disadvantageous. The various cases which have been put forward as proving the existence of Diaposematism in nature were critically examined, and it was contended that the facts could be more satisfactorily interpreted on lines which did not involve the assumption of a mutual interchange of characters between mimic and model. While the great importance of Müller's principle was fully recognised, it was pointed out that it had certain definite limitations, and the attempt to explain all cases of mimicry among butterflies on this theory was contested. On the other hand, it was held that the wide significance of Bates' principle had not been adequately appreciated, and it was urged that this theory would afford an explanation of many cases of mimicry between unpalatable species, which had been previously considered as purely Müllerian in character.

Professor E. B. Poulton, F.R.S., said that at that late hour it was impossible to reply to the details of Mr. Marshall's paper, and that any real discussion of the questions raised by him must be deferred to a future occasion. He would therefore take some other opportunity of exhibiting the specimens which he had specially selected with reference to Mr. Marshall's arguments. He had, however, just received a letter from Mr. S. A. Neave, F.E.S., in the Congo Free State, which, by a curious coincidence, bore upon this very discussion of the relative importance of the Batesian and Müllerian hypotheses. He was anxious that Mr. Neave's observations should appear at once in the Proceedings, and therefore exhibited specimens in illustration of them. He reminded the Society that *Pseudacræa poggei*, Dewitz, was

formerly looked upon as one of the rarest of African butterflies, and that until the recent arrival of material collected by Mr. Neave not a single example of it existed in the national collection. There was almost more *a priori* reason for regarding this butterfly as a Batesian mimic of *Danaida* (*Limnas*) *chrysippus*, L., than any other. Yet this is the very species which Mr. Byatt * observed in 1905 to exist in a proportion of nearly 5 per cent. of its model in a large consignment collected indiscriminately by natives at the sources of the Congo, and the species which Mr. S. A. Neave now finds to be by far the most abundant as well as the boldest *Pseudacræa* in the forests of the Congo Free State in which he has collected. The part of his letter bearing on this question and on the species of *Crenis* and their mimics is as follows:—

"*Kambove, Congo Free State,*
"*November 14th*, 1907.

"Since I last wrote to you I have been out to and just returned from the country to the west of this place—an extremely interesting country, and I wish I had had more time there. I took a large number of remarkable Lepidoptera. Diurnal moths were most abundant in great variety, and of extraordinary coloration. I have not, I am sorry to say, met again with the big mimetic *Pseudacræa*, although the *Aletis* models have been plentiful. *Mimacræa marshalli*, Trim., and *Pseudacræa poggei* were just beginning to reappear at the end of October, and I have taken one of each. *Hypolimnas misippus*, L., has also appeared in small numbers. I still think *P. poggei* the best mimic of *Danaida* (*Limnas*) *chrysippus*, even better than *misippus*—its *flight* is so extraordinarily like that of the model. It is rather, I think, a significant fact that of all the *Pseudacræas* I have met with (5 spp.) *poggei* is by far the most abundant; while it is bold, and not afraid to expose itself on the wing. I have taken a single specimen of a small species of *Pseudacræa* of the *boisduvali* group which I do not know.

"I can now give you a little more interesting information

* Trans. Ent. Soc. Lond., 1905, p. 264.

about the blue spp. of *Crenis* and *Crenidomimas concordia*, Hopff. The country I was in appears to be the metropolis of the genus *Crenis*, and they swarmed everywhere. I have taken *occidentalium*, Mab. (scarce), ? *amulia*, Cr. (very abundant), *rosa*, Hew. (abundant), *pechueli*, Dewitz (very abundant), and at least 2 spp. of the *natalensis* group, one of which is remarkable for an under-surface exhibiting an approach to the coloration and pattern of that of the blue forms. I certainly begin to suspect that the blue species of the genus, if not the others, are distasteful. They are extraordinarily bold and fearless, and collect in very large numbers wherever they can find moisture. They may often be seen, almost in hundreds, round a damp garment in one's camp. Their mimic *Crenidomimas concordia* I found much scarcer, but with very much the same habits. They are very puzzling things, because it must be remembered that they are also extremely addicted to fluttering round and settling on tree trunks often some 10–20 ft. above the ground, and under these circumstances they are *very very inconspicuous*.

"The following groups taken on one day may be of interest:—

October 26th, 1907, Lupepa R.

Crenis pechueli, 5. Near *Crenis natalensis*, group A (with bluish under-surface), 5.

Crenis ? *amulia*, 5. Near *Crenis natalensis*, group B (without bluish under-surface), 3.

Crenidomimas concordia, 1.

October 27th, 1907, 8 miles north of last locality.

C. rosa, 1. *C. amulia*, 2.

C. pechueli, 1. Near *C. natalensis*, group B, 1.

Crenidomimas concordia, 1.

October 30th, 1907.

C. pechueli and *C. concordia* taken at the flowers on the same shrub in two successive sweeps of the net.

"The above groups hardly represent the true predominance in numbers of the *Crenis*, at any rate at this time of the year (the beginning of the rains). Last April and May at the

end of the rains I found both models and mimic scarce, but *concordia* the more common of the two. This, however, was in lower and flatter country, whereas the *Crenis*, especially the large blue ones, are particularly addicted to hills."

Dr. F. A. Dixey said that to deal with Mr. Marshall's criticisms point by point would require another treatise on the same scale as the one now before them. He therefore proposed to reserve any detailed comment for a future occasion. In the meantime he wished to thank Mr. Marshall for his courtesy in allowing him to see the paper before it had been communicated to the Society. He welcomed the opposition therein offered to his own view, because no theory could claim to stand on a firm basis until it had been well scrutinised and had run the gauntlet of adverse criticism. The author of any hypothesis that had been successfully attacked had always the satisfaction of feeling that at least he had helped to arouse interest and to stimulate inquiry; and in any event the cause of truth would be the gainer. No doubt they had from Mr. Marshall as good a statement of his side of the case as any one could make, and if his objections could be satisfactorily met, as in the speaker's opinion they could be, it was not likely that any more formidable assault would have to be faced. It would naturally be expected that he should join issue with Mr. Marshall, and this he undertook to do when the time came; meanwhile he would only make the general remark that *a priori* reasoning in similar matters had before now been known to fail, even when aided by mathematical processes as unimpeachable as those of his present critic.

SPECIAL GENERAL MEETING.

Wednesday, February 5th, 1908.

Mr. C. O. Waterhouse, President, in the Chair.

Proposed Alteration of a Bye-Law.

The Secretary read the following notice communicated to the President and Council of the Society, and read at three previous meetings in accordance with the Bye-Laws.

"We desire that the Bye-Laws of the Society be altered by substituting in Chapter XIII, 3, for £15 15*s.* the figures £21, and give notice under Bye-Law XXI accordingly.

Gilbert J. Arrow.	R. Meldola.
R. Shelford.	A. H. Jones.
T. A. Chapman.	Guy A. K. Marshall.
Louis B. Prout.	G. B. Longstaff."

Mr. A. H. Jones, the Treasurer, then formally moved the above amendment, seconded by Mr. H. Rowland-Brown, and after some discussion the Meeting was adjourned to March 4th.

SPECIAL GENERAL MEETING.

Wednesday, March 4th, 1908.

Mr. C. O. Waterhouse, President, in the Chair.

Proposed Alteration of a Bye-law.

The discussion of the proposed alteration of Ch. xiii, 3, by substituting for £15 15*s.* the figures £21, adjourned from the previous Special Meeting, was resumed, after the circulation of the following data as to composition fees among the Fellows present:—

Data as to Composition Fees, Ent. Soc. Lond., to January 1st, 1907.

Up to 1849, 20 Fellows compounded, and enjoyed (average) 38·4 years each.

1850–1869, 22 Fellows compounded, and enjoyed (average) 38 years each, and 13 survive.

1850–1886, 48 Fellows compounded. Of these—

20 have died with (average) 23·5 years.
28 survive, with (,,) 35 ,,

Since 1886 (last 20 years) 37 have compounded, and only 3 have died.

Composition fees have been invested only since 1868:—£870 18*s.* invested (includes £100 from sale of collections) in £893 consols, present value £768—a loss of 12 % of capital. Yield (after paying income tax) is 2·53 % on capital invested.

On these figures, compounders pay for 18 years' fellowship (less, if loss of capital be taken into account), and receive 38

years—a loss to the Society of £21 on each compounding Fellow, or on 105 compounders of £2,205, as accruing at the dates when he receives the benefits.

It would, however, probably be reasonable to assume that we might do a little better with our investments, say nearly up to $3\frac{1}{2}\%$, with safety.

On this basis the loss, at date of composition, would be, £5 5*s.* each, or £551 5*s.*, at dates of benefits enjoyed about £1,600.

I have obtained the following data and remarks from an actuary (Mr. C. Livingston Milligan, F.I.A.):—

"The average lifetime of the 20 who compounded up to 1849, namely 38·4 years, coincides with the expectation of life by the Institute of Actuaries Healthy Males (H^M) table at age 25, viz. 38·405 years.

"This age agrees with the assumption you make as to the average age at entry (of compounders) being 25 to 30.

"If it be assumed that a member will enjoy the benefits of the Society for life, we must value the annual subscriptions he would pay by an 'annuity due' (that is, first payment now due).

"The value of an annuity due of £1 1*s.* by the H^M table is:—

	3 %	$3\frac{1}{2}$ %
At age 25 ...	£23 2*s.* 9*d.*	... £21 8*s.* 4*d.*
„ 30 ...	£21 18*s.* 3*d.*	... £20 7*s.* 9*d.*
„ 47 ...		... £15 17*s.* 9*d.*

"I consider that the Society could obtain a higher rate than 3 %, after allowing for income tax, by reinvesting.

"My general conclusion is that if it be assumed that the benefits of membership will be enjoyed for life, the composition should be raised to £21. This would be a round figure, and would very fairly represent the actual value of the future annual subscriptions.

"On this assumption, the Society is at present losing £5 5*s.* on each man who compounds."

T. A. C.

After Dr. T. A. Chapman, Mr. W. E. Sharp, Mr. F. Merrifield, Mr. J. W. Tutt, Mr. A. J. Rose, the Rev. F. D. Morice, Mr. G. H. Verrall, Mr. A. Sich, Lieutenant-Colonel N. Manders, and Mr. R. W. Lloyd had spoken to the motion, the President put it to the meeting. There voted in favour 24, and against 27, many Fellows not voting. The motion was therefore lost.

ORDINARY MEETING.

Wednesday, March 4th, 1908.

Mr. C. O. Waterhouse, President, in the Chair.

Election of Fellows.

Major E. F. Becher, of 2, Berkeley Villas, Pittville, Cheltenham; the Rev. K. St. Aubyn Rogers, M.A., of Rabai, Mombasa, British East Africa; and Mr. Claude Rippon, M.A., of 28, Walton Street, Oxford, were elected Fellows of the Society.

Obituary.

The decease of Mr. Herbert Goss, F.L.S., for many years a Secretary of the Society, was announced, and the President having given an account of the services rendered the Society by the deceased gentleman, said that the Council had unanimously approved a letter of sympathy to be sent to Mrs. Goss.

Exhibitions.

Aberrant Coleoptera.—Mr. F. B. Jennings exhibited a remarkable specimen of the common Chrysomelid beetle, *Sermyla halensis*, L., from Deal (ix, 1907), showing unusual coloration of the elytra, which are blue and coppery-red, instead of bright green; the specimen is also unusually compressed in shape, and has the legs and antennæ shorter than in normal examples: and on behalf of Mr. C. J. Pool, a specimen of *Otiorrhynchus tenebricosus*, Herbst, from Newport, I.W., and of *Barynotus obscurus*, F., from Galway, Ireland, in the first of which both the false mandibles were present, and in the second of which they were not toothed.

Weevils showing false mandibles.—Mr. F. B. Jennings also showed a specimen of the weevil *Phyllobius maculicornis*, Germ., retaining both the "false mandibles," and another in which one of them is intact, both from Enfield (v, 1907); also a single example of *P. urticæ*, De G., from Cheshunt (v, 1907), retaining one of these "mandibles," the particular point of interest in connection with the "false mandibles" in these species being that they were toothed in the centre.

Mr. H. St. J. Donisthorpe also brought for exhibition *Otiorrhynchus sulcatus*, *Polydrusus sericeus*, and *Omias bohemanni* with these appendages still attached. The *Otiorrhynchus* was dug up in its pupal cell at Oakham in 1895.

Melitæas from South Switzerland.—The Rev. G. Wheeler showed a case containing specimens of Melitæid butterflies taken by him at Reazzino in Tessin, near Bellinzona, which he had identified with Assmann's *Melitæa aurelia*, var. *britomartis*, they being absolutely identical with the specimens so labelled in the Swiss national collections at Berne. The close affinity with *M. dictynna* on the under-side makes separation superficially difficult, and until all forms are reared from the ovum it would be impossible to determine whether *britomartis* constitutes a separate species or not. Mr. J. W. Tutt said that the only forms of the species which he had seen resembling those exhibited had been taken by Dr. Chapman at Campiglio, in the Southern Tyrol, where the conditions of soil and climate would be more or less similar to those at Reazzino. Despite the fact that Mr. Wheeler had found *M. dictynna* flying on the same spot between the times of the two broods exhibited, he was of opinion that the specimens were a form of *dictynna*.

Papers.

The following papers were communicated :—

"Descriptions of New Species of Lepidoptera-Heterocera from South-East Brazil," by H. Dukinfield Jones, F.E.S.

"*Erebia lefebvrei* and *Lycæna pyrenaica*," by Dr. T. A. Chapman, M.D., F.Z.S.

"A Contribution to the Classification of the Coleopterous Family *Dynastidæ*," by Gilbert J. Arrow, F.E.S.

"Hymenoptera-Aculeata Collected in Algeria by the Rev. A. E. Eaton, M.A., F.Z.S., and the Rev. F. D. Morice, M.A., F.E.S. Part III, *Anthophila*," by Edward Saunders, F.R.S.

Wednesday, March 18th, 1908.

Mr. C. O. Waterhouse, President, in the Chair.

Election of Fellows.

Mr. Edwin Goldthorp Bayford, of 2 Rockingham Street, Barnsley; Mr. Edgar L. Clark, of Congella, Natal; Mr. G.W. Jeffrey, of the Alpine Gold Mining Company, Barberton, Transvaal Colony; Mr. G. W. Lawn, of Tudor House, Wealdstone, Harrow, and Mr. D. Langsdon, of 20 Holland Park, W., were elected Fellows of the Society.

Exhibitions.

Early Stages of Papilio homerus.—Dr. T. A. Chapman exhibited photographs of the empty egg-shells and young larvæ of *Papilio homerus*.

Larvæ of Trictenotoma and Dascillus.—Mr. C. J. Gahan brought for exhibition a larva of the genus *Trictenotoma*. This larva belonged undoubtedly to the Heteromera, and bore most resemblance to the larvæ of *Pyrochroidæ*, and *Pythidæ*. He also showed a larva of *Dascillus cervinus* from Ireland, which had been received at the Natural History Museum by Mr. Waterhouse, a species little known in this stage.

The President said that the larva in question was just now the subject of experiment, it being reported as doing much damage to grass-land. It was important, therefore, to determine whether it was really destructive, or parasitic on some other pest like *Melolontha*.

Larvæ of Coniopteryx.—The President exhibited a coloured drawing of the larva of *Coniopteryx*, a small neuropteron common enough in its perfect state, but rarely found as a larva, when it may be beaten out of fir trees.

Association of Pierine and Nymphaline Butterflies.—Mr. W. J. Kaye brought for exhibition three *Pereute* species from the Chanchamayo district of Peru, viz. *P. leucodrosime*, *P. callinice* and *P. callianira*, together with specimens of the Nymphaline *Adelpha lara*. He called attention to the fact that these Pierines and Nymphaline occurred together at an

elevation of from 2,500 to 3,000 feet. It was wrong to suppose that any *Heliconius melpomene*-like species entered the association as *Heliconius* species of this pattern did not ascend to such an elevation, or if they ever did it was only as a rare exception.* The *Heliconius* species that did occur and occur plentifully were *H. xenoclea* with the closely similar *H. microclea*, each of which had two red bands on the fore-wing. Dr. F. A. Dixey had in his memoir "On the Relation of Mimetic Patterns to the Original Form" in the Transactions for 1896, discussed the likelihood of *H.* "*melpomene*" obtaining its red spots at the base of the abdomen on the under-side from the Pierine *Pereute leucodrosime*. What has been stated above, however, made such a conclusion impossible. The *Adelpha lara* formed a much better mimic than any *Heliconius* by reason of its more rounded and broader wing outline in addition to the colouring which in the fore-wing was extremely alike. On the under-side, if when both *Pereute* and *Adelpha* are at rest they conceal the coloured portion of the fore-wing the hind-wing would then give a very strong similarity of one to the other.

Variation in Smerinthus populi.—Mr. L. W. Newman exhibited a long and varied series of *Smerinthus populi* bred from wild Bexley parents in June 1907, the series ranging from extreme dark specimens (about six per cent.) to very light (about ten per cent.), and pink shaded or tinged (about twenty per cent.): the remainder being intermediate forms.

Three gynandromorphic specimens were bred (one of which was exhibited); in two of these the only clue to their being gynandromorphous being the antennæ, ♂ on left, and ♀ on right side; while in the third specimen the wings were much larger

* Such is the evidence of Messrs. Watkins and Tomlinson, who have collected and sent home many thousands of butterflies from Eastern Peru. In the "Macro Lepidoptera of the World" (Seitz), Vol. II, p. 4 (1908), it is stated, however, that in Colombia *Pereute leucodrosime*, *Adelpha isis*, *Papilio euterpinus* and *Heliconius melpomene*, all occur together on the same bush. If the *Heliconius* species had been given as *H. guarica* or *H. hydara*, the statement might have been accepted, but as *H. melpomene* is essentially a low-level species, it is scarcely possible that it can ever be observed with *Pereute* species, which do not occur near sea-level. The statement needs confirmation. If *H. guarica* be substituted for *H. melpomene*, we still have a most interesting combination, and one whose units are different to those in Peru.—W. J. K.

on the ♀ side, and colour and markings different to the ♂ side.

Forms of Everes.—Mr. J. W. Tutt asked for information from Fellows who had collected abroad, relative to a suggested distinction of the Lycænid butterfly, *Everes argiades*, Pall. He said that the question had been raised by M. C. Oberthür whether we have under ab. *coretas*, O., and *argiades* two separate and distinct species.

A discussion followed in which the Rev. G. Wheeler, Dr. T. A. Chapman, Mr. H. Rowland-Brown and other Fellows took part, and Fellows having specimens in their collections were asked to bring series for comparison and discussion.

Paper.

Mr. C. J. Gahan, M.A., communicated a paper, "On the Larvæ of *Trictenotoma childreni*, Gray, and *Melittomma insulare*, Fairmaire."

Wednesday, April 1st, 1908.

Mr. C. O. Waterhouse, President, in the Chair.

Election of Fellows.

Mr. F. B. Ackerley, P.O. Box, 459, Port Elizabeth, South Africa; Mr. Charles G. Clutterbuck, Heathside, Heathville Road, Gloucester; Mr. P. A. Clutterbuck, Indian Forest Department, Naini Tal, United Provinces, India; Mr. Walter W. Froggatt, F.L.S., Government Entomologist, New South Wales; Mr. H. A. Nurse, Botanical Department, Trinidad, B.W.I.; Mr. William Boulton Pratt, 10, Lion Gate Gardens, Richmond, Surrey; Mr. Edward Richard Speyer, Ridgehurst, Shenley, Herts., and New College, Oxford; Mr. G. Talbot, Vine Cottage, Raleigh Road, Enfield, N.; and Dr. F. Creighton-Wellman, Cuidado de Senhores Silva & Lopes, Benguella, Africa Occidental, were elected Fellows of the Society.

Obituary.

The decease was announced of Mr. F. C. Lemann, and Mr. T. P. Furnival, Fellows of the Society.

Exhibitions.

Melanism in a Beetle.—Mr. F. B. Jennings exhibited on behalf of Mr. R. A. R. Priske a melanic aberration of the stercorarious beetle *Aphodius scybalarius*, Linn., taken at Deal, in June 1907. The usual colour of the elytra of this species is brownish-testaceous, with two more or less pronounced dark patches at the side, and the melanism consisted of an extension of these patches, nearly covering the elytra.

Fungoid growths on Lepidoptera.—Mr. E. R. Bankes sent for exhibition :—

(1) Four specimens of *Hepialus humuli*, L., more or less covered by a sprouting fungoid growth, which was said by the editor of the "Field" newspaper, in 1880, to be possibly an early stage of a species of *Clavaria*, and to have attacked the moths after death.* Mr. Bankes had only met with eight Lepidopterous imagines thus affected, and had received one from a friend; all of them appeared to be males of *H. humuli*. They were found in the heath district of south-east Dorset, mostly attached to shoots of *Ulex europæus*, though *U. nanus*, *Calluna vulgaris*, and *Erica ciliaris* each yielded a solitary example.

(2) Many dead larvæ of *Hepialus lupulinus*, L., infested with the fungus *Cordiceps entomorrhiza*, and received from

* "It has after death become accidentally covered by a fungoid growth (possibly an early stage of a species of *Clavaria*), which would have developed just as well if its spores had found a resting-place on any other sufficiently damp substance. It was not the cause of death (though a minute fungus, *Empusa muscæ*, very commonly kills flies in autumn, and a prevalent cause of death in silkworms is owing to a fungus). Fungi of the genus *Sphæria*, *Sphærularia*, etc., have often been recorded as growing both on the larvæ and perfect insects of various Lepidoptera, Coleoptera, Orthoptera, Hemiptera, and Hymenoptera, both in this country and in Australia, the East and West Indies, North America and elsewhere. Curiously enough, the late Sir W. J. Hooker has recorded a *Clavaria* as found on the larva of an *Hepialus*. In Griffith's edition of Cuvier's 'Animal Kingdom' (Ins., Vol. ii, pl. 137) is a figure of a large hawk-moth covered with *Isaria*, a parasitic fungus."—From the "Field," 1880.

Mr. W. H. B. Fletcher, in whose flower garden at Bognor they had been found. The larvæ of this species prove destructive there, feeding on the roots of *Helleborus*, *Iris*, *Pæonia*, and, in fact, on everything with available roots, but the infested larvæ are only obtained from certain clumps of *Pæonia officinalis*, working to the surface during the winter months. The larvæ are of two classes :—

(*a*) Some show anteriorly much fibrous net-like mycelium growth, accompanied by a drumstick-like process often more than half the length of the larva ; these larvæ do not work out of the ground, but the fungoid fructification appears above ground, resembling a small reddish toad-stool, and the net-like mycelium seems to anchor the larvæ in their places.

(*b*) Others show no fungoid growth externally, and these work completely out of the soil, and lie about on the surface. Mr. Fletcher suggests that the dead larvæ perhaps arrive there through the movement of the soil, resulting from sunshine and rain, frost and thaw, acting on the larval hairs, and allowing a forward but not a backward motion.

The drumstick growth shown by the former class resembles in miniature the well-known process that springs, through the soil, from the dead larvæ of moths of the New Zealand Hepialid genus *Porina*, when infested by the fungus, *Cordiceps robertsii*.

Tongue of an Ochromyia.—Professor Poulton exhibited a preparation of the tongue of the fly *Ochromyia jejuna*, made by Mr. E. Ernest Green, F.E.S., and gave an account of some fresh observations recorded by him. These new facts, bearing upon the discussion in Trans. Ent. Soc. Lond., 1906, pp. 394–6, were contained in a letter written Nov. 6, 1907, from which the following passages were quoted :—

"*Peradeniya, Ceylon.*

"A flight of winged Termites came into my bungalow last night, and I was fortunate in witnessing an attack by the fly —*Ochromyia jejuna*—upon one of them. Several of the Termites had shed their wings. The fly pitched beside one of them and followed it for some time, making half-hearted feints at attack before it finally seized it. I could see that the point of attachment was at about the middle of the dorsal surface of the abdomen. As the fly seemed inclined to carry off its

victim, I covered the pair with a glass bowl. But this alarmed the fly and it released its hold and refused to renew the attack. So I bottled the specimens and have been examining them this morning. I find that the segmental rings of the Termite are partially separated and that there is a distinct wound in the soft intersegmental tissue, from which the juices of the body are exuding. I next dissected out the tongue of the fly and —after boiling in liq. potass.—mounted it in glycerine. I was interested to find that—far from being unarmed—there is quite a battery of strong chitinous teeth and slender lancet-like points on the inner face of the apical lobes. There is first a stout median conical tooth. Near the centre of each lobe are two very dense stout curved teeth, the outermost bidentate, the inner one with small denticule on one side. Slightly above this is a series of smaller bidentate teeth—two of them mesad and one laterad of the larger teeth. Above these again is a close series of some thirteen or more sharply-pointed ligulate processes.

"In view of these very effective-looking weapons, it can scarcely be maintained that the fly is incapable of inflicting a wound.

"As this question was brought prominently before the public in your recent exhaustive paper on predatory insects, you might—if you consider these notes of sufficient interest—read them at a meeting of the Entomological Society."

Professor Poulton said that he had shown the preparation to Colonel J. W. Yerbury and to Mr. J. E. Collin, both of whom had compared the structure to that of the tongue in such Diptera as *Caricea tigrina*, F., and *Stomoxys calcitrans*, supporting the conclusion that *Ochromyia jejuna* possessed similar habits and powers of attack.

Papers.

Mr. J. E. Collin communicated "The Systematic Affinities of the *Phoridæ* and of several Brachycerous Families in the Diptera," by Mr. W. Wesché, F.R.M.S.

Dr. T. A. Chapman, M.D., F.Z.S., read a paper on "*Stenoptilia grandis*, n. sp."

Wednesday, May 6th, 1908.

Mr. C. O. Waterhouse, President, in the Chair.

Election of Fellows.

Mr. Thomas Godfrey Andros, Ph.D., F.Z.S., of Wilton House, 31 St. Saviour's Road, Jersey; Mr. Chourappa Chetti, Assistant Curator of the Government Museum at Bangalore, India; Mr. Frederick Charles Fraser, I.M.S., M.D., M.R.C.S., L.R.C.P., of Trichinopoly, India; and Mr. Walter M. Giffard, of Keeaunoki Street, Honolulu, Hawiian Islands; and Mr. Alfred Vander Hedges, of 42 Kensington Park Gardens, W., were elected Fellows of the Society.

Obituary.

The decease was announced of Mr. Francis Ford Freeman, a Fellow of the Society.

Exhibitions.

Aberrant and Living Lepidoptera.—Mr. A. H. Jones exhibited an example of the melanic ab. *nigra* of *Tephrosia consonaria* bred from a wild ♀ taken at Wateringbury, near Maidstone, by Mr. W. Goodwin; and a living larva of *Sesia andreniformis* feeding in the stem of *Viburnum lantana*, found by Mr. F. J. Robinson.

Blattidæ in Amber.—Mr. R. Shelford exhibited some Blattidæ in amber, forming part of the collection of Dr. R. Klebs, of Königsberg; the specimens came from the well-known deposits of Lower Oligocene age in East Prussia, celebrated even in Roman times for the large quantities of amber found in them. A great monograph on this amber fauna was written in the years 1845–1856 by Berendt and Germar; in this work 5 species of Blattidæ are figured and described, but very little has been written since then on the subject. A preliminary examination of Dr. Klebs' collection shows that it contains representatives of six genera which are identical with recent genera. These are *Ectobia* (2 species), *Ischnoptera* (1 or 2 species), *Phyllodromia* (4 to 5 species),

Temnopteryx (1 species), *Periplaneta* (1 species), *Holocompsa* (1 species). It is remarkable to find the genera *Ectobia* and *Holocompsa* existing side by side, for at the present day the former genus is confined to the Palæarctic region, whilst the latter is essentially a tropical genus. Both the species of *Ectobia* represented in the collection are allied to the recent *E. lapponica*, L., and it is difficult to avoid the conclusion that the genus was one of the few that were not driven from Europe by the onset of the glacial epoch, or in other words, *E. lapponica* appears to be a lineal descendant of the amber-enclosed species *E. baltica*. *Phyllodromia* is now represented in Europe by one doubtfully-indigenous species, but is represented by scores of species in the tropical and sub-tropical regions of the world. *Ischnoptera* and *Temnopteryx* are now found in all regions of the world except the Palæarctic. The collection affords still further proof, if any was required, that the climate of Europe in Oligocene times was tropical or sub-tropical.

Living Blatta.—The President exhibited a living example of *Blatta* found in bananas from Mexico. Mr. Shelford said he thought the species to be *Panchlora nivea*, Linn.

Nudaria senex and Calligenia miniata.—Mr. H. M. Edelsten showed a living larva of *Nudaria senex*, and living larva and pupa of *Calligenia miniata*. He drew attention to the clubbed bristles on the former as being incurved and most curious; and also to the hair tufts on the fifth segments of *miniata* as being much darker than on the remaining segments.

Albinism in Epinephele jurtina.—Mr. O. E. Janson exhibited a white aberration of *Epinephele jurtina*, taken by Mrs. Elliot in Holme Park, Sussex, in June 1904. The wing coloration was entirely white, with the fulvous blotches on the anterior decidedly bright and strong.

Rhinoceros bicornis followed by extraordinary Œstrid flies (*Spathicera*) mimetic of a large species of Salius (*Pompilidæ*).—Professor E. B. Poulton, F.R.S., said that when he visited Stockholm last May in connection with the Linnæan Jubilee, Professor Yngve Sjöstedt had shown him a number of large Dipterous larvæ which he had obtained from

the stomach of *Rhinoceros bicornis* during his Kilimanjaro-Meru Expedition in 1905–6. Professor Sjöstedt had managed to breed a single imago, and it was a wonderful *Salius*-like insect, blue-black with orange legs like its model—large, but with something of the slender build of a Fossor. Professor Sjöstedt had recently published an interesting paper on the *Œstridæ* of his expedition (Königl. Schwedisch. Acad. Wissenschaft., Uppsala 1908, 10. Diptera, 2. Œstridæ, p. 11). In this memoir he had described and figured the species as *Spathicera meruensis* In addition to this species, known in larval pupal and perfect states, two other species had been named from larvæ found in the digestive tract of the same mammal:—*Spathicera* (*Gyrostigma*) *conjungens*, Enderl., and *S.* (*G.*) *rhinocerontis bicornis*, Brauer—neither known in any later stage. Up to the present time no observation had been recorded of any Œstrid in the perfect state associated with or following *Rhinoceros bicornis*. But now only a few days ago the speaker had received a letter from Mr. S. A. Neave, M.A., B.Sc., F.E.S., from N.E. Rhodesia, describing what was evidently a fly of the genus *Spathicera*, as persistently following *R. bicornis* in that district. He reproduced the account in Mr. Neave's own words:—

"*Upper Luangwa Valley,*
"*Feb.* 20, 1908.

"The other day I shot a fine Bull Rhinoceros. It was accompanied by three very large and extraordinary flies. They refused to leave its carcase, and were easily caught by hand, but I hesitated some time before doing so, as they have a *marvellous* resemblance to the large blue-black, orange-legged Hymenoptera which are so common throughout this country. I wonder if they are a known species? I suppose they must be as they are quite the most striking-looking both in colour and size that I think I have ever seen amongst Diptera. I am sorry to say that I was unable to ascertain what was the nature of their association with the Rhino."

Professor Poulton said that it was extremely satisfactory that Mr. Neave had now been able for the first time to put on record the association of a fly of the genus *Spathicera* with *Rhinoceros bicornis*.

The Bulbul feeding its young on specially protected insects.—Professor Poulton communicated an interesting observation sent to him from the Nilgiris by Mr. H. Leslie Andrewes:—

"*Barwood Estate, Guynd P.O., Nilgiris,*
"*March* 19, 1908.

"This afternoon I was sitting under the veranda, with my head within about five feet of a red-whiskered bulbul's nest containing two young birds about five days old. One of the parent birds arrived with the very last butterfly I should have expected it to have any dealings with, viz., *Acræa violæ*. It sat on a stalk of the tall clump of cannas in which the nest is built, eyeing me for nearly a minute. I noticed that the butterfly was well in the bird's bill, firmly held, with the wings in considerable disarray. The body must have been fairly well crushed, so that the bulbul must have been fully alive to the flavour. I put my head within about three feet of the nest to see how the young birds took it. The bird went down and pushed the butterfly well into a youngster's throat, and it was swallowed immediately, wings and all, and the young bird settled quietly down without seeming in the slightest degree upset. To judge from Marshall's S. African notes the Acræas are in anything but good odour as food, even when the bird or insect to which they are given is hungry, so that I was rather surprised to find birds voluntarily feeding their young on one. There is other food in ample quantities for them. I spent an hour and a half after tea in seeing what they brought. I sat within five feet of the nest with a pair of glasses with which to make things out more clearly. In twenty visits (both parents) I failed eleven times to see what they brought, either through the birds being too quick for me, or through not being able to make out small insects, and so on. What I did see were:—three spiders, one Noctuid larva, two crickets, a bright red beetle which *looked* like a Lycid, though I couldn't be certain of this (the only other red beetle in these parts of that shade is a velvety Clerid, as far as I know), and a large black and white Hypsid moth, I think *Hypsa complana*. This was crammed into the young bird's throat, and he had

much trouble in getting it down. I have always imagined (on pure supposition) that *Hypsidæ* were distasteful. If I can see anything more before posting this, I will add it later."

"*March* 23.

"I have watched the nest at intervals since, but have seen nothing out of the common brought, only larvæ, grasshoppers, spiders and so forth, and berries."

[A later communication from Mr. H. Leslie Andrewes, dated May 4, contained further interesting notes on the habits of these insectivorous birds:—

"The whole thing, as is usual with these silly birds, came to grief a day or two after my observations, as the nest was tied on anyhow to decaying cannas. I fixed it up for them once or twice, but it capsized one night, and the family disappeared. There was *unlimited* food for old and young; the garden was full of grasshoppers (which formed a large part of their food), also caterpillars. For all this, at about every third visit, if not more frequently, the parents stopped to swallow the young birds' excrement. Perhaps I should have made a note of it, but I knew that thrushes did this*—I have seen them do so—and thought it was a more or less universal custom with birds, and so did not mention the fact; they always swallowed the excrement before flying off. It is a curious habit, and in this case I am sure it was not done from hunger."]

Professor E. B. Poulton said that the bulbul was probably little affected by properties which were a protection against the majority of insect-eating birds. Mr. Andrewes' observation helped us to a knowledge of the special enemies of specially defended insects, and was further evidence of Haase's error in applying the unqualified term "immune" to any insect, however unpalatable. Monsieur Charles Oberthür had argued "(Études de Lepidoptérologie comparée": Fasc. ii, Rennes, Oct. 1906, p. 25–27) from cases such as these that there is no significance in any special defence or the accompanying warning (aposematic) colours. This distinguished naturalist,

* For an observation of the kind alluded to, see "Nature," vol. lvii, April 14, 1898, p. 554.

seeing in nature that every living being served as the food of some other being, arrived at the conclusion that the order of things is fixed and unchanging, and that by sure instincts and keen senses the insect-eating animals found their prey, unhindered by concealment or by any other mode of protection. M. Oberthür believed in short that the very words "concealment" and "protection" only represent an unsound anthropomorphic inference, for, in his opinion, neither concealment nor protection from enemies is ever afforded. From a study of the same struggle for existence the majority of naturalists have come to very different conclusions. They saw evidence for the existence of a balance between the aggressive and protective forces, and believed that in maintaining this balance cryptic colours and warning and mimetic patterns were of essential importance to numberless species. They recognised the usual ultimate success of the enemies of insects, but also saw that this success involved hard work and much time spent in the chase, and that in fact the relationship between pursuer and pursued was precisely of the kind to strengthen the faculties and powers of the one and gradually improve the protective methods of the other.

Professor E. B. Poulton also exhibited two female specimens of *Laphria gilva*, L., captured with prey (Sept. 1906) at Grinderwald, Hanover, by Dr. Karl Jordan. One female, captured *in coitû*, was devouring the Pentatomid bug, *Dolycoris baccarum*, de G., male; the other was carrying a worker of *Vespa rufa*, L. *Asilidæ* preying upon the formidable Diploptera had often been recorded from tropical countries, but never before, so far as the speaker was aware, from Europe.

Professor E. B. Poulton then made the following communication:—

On the species of Neptis in the islands to the E. and the N.W. of Madagascar.—My attention was first directed to the interesting and puzzling problem presented by these species by the recent communications of Colonel N. Manders, F.E.S., and by the specimens collected by him in Mauritius and Bourbon. The considerable difference in detail between *Neptis frobenia*, F., of Mauritius, and *N. dumetorum*, Boisd., of

Bourbon, at first suggested that the two species were not nearly allied, and that their marked superficial resemblance may have been due to mimicry. At the same time any attempt to explain the growth of a mimetic likeness presented the gravest difficulties. The details of the pattern of *dumetorum* indicated close affinity with the black and white *Neptis saclava*, Boisd., of Madagascar and the mainland of Africa; while the much greater simplification, especially on the under surface, of *frobenia*, suggested affinity with the Austro-Malayan species of the group of *N. consimilis*, Boisd. If this interpretation were correct, *frobenia* would take its place beside the species of *Euplœa* as representatives of an Eastern butterfly fauna. Mr. G. A. K. Marshall has, however, carefully examined the neuration of these species, as well as *N. comorarum*, Oberth., from the Comoros, and *N. mayottensis* from Mayotte, and has compared them in this respect with *saclava* and *consimilis*. His results leave no doubt that, as regards this important character, *N. frobenia*, as well as the other three species of *Neptis* in the islands surrounding Madagascar, is closely related to *saclava* and remote from *consimilis*. Mr. Marshall has kindly drawn up the following account of the evidence of affinity based on neuration :—

"*Neptis frobenia*, F., from Mauritius, differs from the superficially similar *N. consimilis*, Boisd., from the Austro-Malayan islands, and agrees with *saclava*, Boisd., in the following neurational characters :—

"In *frobenia* the origin of vein 10 of the fore-wing is much nearer to apex of the cell, so that its distance from that point on the distal side is approximately equal to the distance of vein 11 from the same point on its proximal side. In the hind-wing veins 6 and 7 are very close at their origin, and vein 5 has a sharp curve at its base, representing a rudimentary discocellular.

"In *consimilis* the origin of vein 10 of the fore-wing is much further removed from the apex of the cell, its distance being almost three times as great as that between vein 11 and the same point. In the hind-wing veins 6 and 7 are appreciably separated at their origin, while vein 5 is scarcely curved at the base, giving the upper edge of the cell a much flatter outline.

"In all these characters *frobenia* agrees closely with the other yellow-marked *Neptis* of the African islands that I have examined, viz.: *N. dumetorum*, Boisd., *N. mayottensis*, Oberth. and *N. comorarum*, Oberth."

Dr. Karl Jordan kindly consented to investigate the evidence of affinity founded upon the male genital organs. The following account prepared by him entirely supports Mr. Marshall's conclusions, although I was at the time unfortunately not able to submit either *comorarum* or *mayottensis* to dissection.

"*Neptis saclava*, Boisd., and its nearest allies differ from the majority of the species of *Neptis* in one very conspicuous character in the genital organs. The clasper of these species

is divided by a narrow sinus at the apex into two lobes. The ventral lobe (Fig. A, *a*) is broad and rounded, being almost the same in the various allies of *saclava*. The dorsal lobe (*b*), on the other hand, exhibits easily recognised specific differences. This lobe is somewhat twisted. In *saclava* (Fig. A) the top of the dorsal lobe lies over the outer surface of the ventral lobe, not being visible in a view from the inner side as here represented. Dorsally the lobe bears a thin ridge which is more or less denticulate. This ridge projects more in Continental specimens (*N. saclava marpessa*) than in Malagasic ones (*N. s. saclava*, Fig. A). The specimens dissected show some individual variability in the shape of the lobe.

"*N. nemetes* as well as *metella* have a similar though not identical clasper, agreeing in this respect better with *N. saclava* than do *N. dumetorum* and *frobenia*.

"In *dumetorum* (Fig. B) the dorsal lobe is almost half-crescent-shaped when looked at from the apical side, the dorsal surface of the lobe being much wider than in *N. saclava*, and the dorsal angle of the lobe projects much more than in *N. saclava*. I have examined two ♂ ♂.

"In *frobenia*, of which I have examined only one specimen, the lobe is more compressed than in *N. dumetorum*. The apex of the lobe is dentate and the dorsal angle is produced into a thorn-like process.

"I may add that the tawny Oriental *Neptis* have quite a different clasper, the similarity in colour with *frobenia* and *dumetorum* being superficial. I have not been able to examine *N. comorarum* and *mayottensis*."

This convergent evidence renders it certain that the four tawny-marked species of *Neptis* in the islands surrounding Madagascar, are all closely related to one another and to the white-marked *saclava* in Madagascar itself. The next point which required clearing up was the distribution; for although each tawny species is known to exist in a separate island (or perhaps group of islands in the case of *comorarum*), outside Madagascar, *frobenia* and *dumetorum* have both been stated to occur in Madagascar as well. In settling this point it was convenient to decide with it the precise distribution of the species of *Euplœa* in the outlying islands, for some of these have also been affirmed to exist in Madagascar. Upon this subject Monsieur Charles Oberthür can speak with greater authority than any living naturalist, and he has kindly answered my questions in detail. Writing on April 30th and May 4th, he says :—

"*Neptis dumetorum*.—Tous les exemplaires que j'ai vus viennent de l'île Bourbon. Jamais je n'ai vu *dumetorum* provenant d'une autre localité.

"*N. comorarum*.—Tous les exemplaires ont été pris aux Comores; jamais ailleurs.

"*N. mayottensis*.—J'ai reçu seulement un petit nombre pris à Mayotte. Toujours *mayottensis*."

Concerning *frobenia* he writes :—"Jamais *Neptis frobenia* n'a été rencontré à Madagascar—du moins d'après ce que je connais—mais seulement à l'île Maurice."

"Quant aux *Euplœa*, je crois *goudoti* spéciale à l'île Bourbon; *euphone*, à Maurice; *desjardinsi*, à Rodriguez; et *mitra*, aux Seychelles. Je possède les 4 espèces. Mais jamais je n'ai reçu aucun exemplaire de *goudoti*, ou *euphone* à Madagascar."

I am also informed by Mr. H. Grose-Smith, F.E.S., that he has never received any of the following species from Madagascar :—*Neptis dumetorum*, *N. frobenia*, *Euplœa euphone*, and *E. goudoti*. The erroneous statements as to the occurrence in Madagascar of certain species of *Euplœa* and *Neptis* confined to the outlying islands, are probably due to Mabille; but they are unfortunately repeated, although sometimes queried, by Aurivillius.

Each of the four outlying forms of *Neptis* may therefore be looked upon as the product of its own island, and a very interesting problem of evolutional history is presented to us. One great difficulty in attempting its study was the want of specimens from the Comoros and Mayotte. So far as I am aware the single specimen of *mayottensis* in the British Museum is the sole example of these two forms, in this country. I therefore wrote to Monsieur Charles Oberthür, of Rennes, asking for information concerning the pattern of *comorarum*. With great generosity my kind friend at once presented to the Hope Collection the interesting examples of *comorarum*, *mayottensis*, *dumetorum*, and the Madagascar form of *saclava* which are now exhibited. The two specimens of *comorarum* and the *mayottensis* formed part of the collection made by L. Humblot (1885–6).

Comparing the four species it is at once evident that the eastern pair *dumetorum* and *frobenia*, are related together and quite distinct from the north-western pair, *mayottensis* and *comorarum*, which are even more closely related to each other. Furthermore, as we should expect from their more isolated position, the eastern species are far more distantly removed from the Madagascar *saclava* than the north-western; while in each pair the species from the outer island is far more remote from *saclava* than the species in the island which is

nearer to Madagascar. *Mayottensis* indeed appears to be so near to *saclava* that there is practically nothing but colour to separate it. In the British Museum it is accorded subspecific rank only. Its close affinity to *saclava* was pointed out by Oberthür in the original description.

So far as it is possible to infer from a very limited number of specimens in a group where individual difference in size is strongly marked, *dumetorum* is the largest of the five species, then *saclava*, then *frobenia*, while the two north-western species, which appear to be about equal in size, are the smallest.

The tawny markings of the upper surface are much deeper in tint in the eastern species: *frobenia* is in this respect slightly but distinctly darker than *dumetorum*. *Comorarum*, on the other hand, is almost precisely of the same pale tawny shade as *mayottensis*. It may be faintly deeper in tint, but I could not feel certain of this. The ground-colour is blackest in *dumetorum*: in *frobenia* it is of a much duller browner shade.

In the north-western species the relative shape and proportions of the chief markings on the upper surface are very similar to each other and to the white markings of the Madagascar *saclava*. In *comorarum*, however, the band of the hind-wing is considerably narrower, and is not prolonged on to the fore-wing as it is in all the other species of this group. This extension on the fore-wing is largest in *saclava* and *mayottensis*, smaller in *dumetorum*, and still smaller but quite distinct in *frobenia*. In the eastern species the band of the hind-wing is not only still narrower, but possesses, in *dumetorum*, a markedly crenulate outer margin which gives it a very distinct appearance. In some individuals of *frobenia*, slight but obvious traces of this outline are a further indication of affinity between it and *dumetorum*. Each crenulation occupies an internervular space, and is concave in form. In *saclava*, on the contrary, the outer border of the band projects as more or less of a convexity into each internervular space. The difference may be expressed by saying that the outer margin of the band is formed of concave crenulations in *dumetorum*, of convex crenulations in *saclava*.

As regards the markings of the under surface and of the

upper (notwithstanding the one distinguishing feature described above), *comorarum* is far nearer to *saclava* than is *frobenia* or even *dumetorum*. In the north-western species the markings on the under surface are paler than those of the upper, while the minute markings are lighter than the larger. The under side of *dumetorum* is remarkable in the fact that the chief spot of the fore-wing is fulvous while the other markings and those of the hind-wing are white. Indications of the same contrast exist, although far less developed, in *frobenia*.

These are the chief characteristics of colour and pattern which distinguish the four island species from one other and from the Madagascar *saclava*. It is of great interest to attempt the difficult task of reconstructing some stages of the past history of the group. We may confidently assume, from the greater affinity to *saclava* on the innermost island on each side, that all the four forms were derived from Madagascar; and, if amount of change be a measure of period of isolation, that *frobenia* was first isolated, *dumetorum* second, *comorarum* third, and *mayottensis* fourth. We must if possible distinguish in each case between ancestral characters which have persisted from a period previous to the isolation, and recent characters which have been evolved since its beginning. The former are of special interest in that they suggest to us some of the features which *saclava* has now lost in Madagascar.

a. Ancestral Features.—1. *The Band Crossing the Hind-Wing.—Saclava* in Madagascar has a considerably broader band than on the mainland of Africa. It is probable that the Madagascar *saclava* also formerly possessed a narrower band, which still persists in three out of the four island forms. It is probable that the band of *saclava* has been widened in consequence of synaposematic approach to the other species of *Neptis* in Madagascar, and perhaps partially under the influence of *Amauris nossima*, Ward, in which the white markings are so strongly developed. The synaposematic sensitiveness of *Neptis* to the African species of *Amauris* as well as to other *Danainæ* in other regions has been referred to in Trans. Ent. Soc. Lond. 1902, pp. 467–8. *Neptis kikideli*, Boisd., of Madagascar, described as a common species by Mabille, is distinguished by a great development of the white markings, and

Mr. Grose-Smith informs me that he possesses an allied undescribed species from the same island with even broader bands, especially upon the posterior wings. Furthermore *Neptis metella*, D. and H., is represented in Madagascar by the form *gratilla*, Mab., in which, as in *saclava*, the white markings are larger than in the African form. Another black and white species, *N. sextilla*, Mab., is unknown to me. There is therefore clear evidence of the existence in Madagascar of a powerful combination in which the white markings are especially well developed.

2. *The Tawny Markings of the Island Species.*—It is difficult to decide between the two alternative interpretations of the difference in colour between *saclava* and the four species in the outlying islands. If white markings are ancestral in *saclava* it follows that the tawny colour has been evolved independently in the north-western and eastern species. Furthermore we have no cause to assign for the change except the vague and unsatisfactory one of isolation. The relationship of the two north-western species is also opposed to this interpretation. We may infer from the differences between them that *comorarum* has been isolated for a much longer period than *mayottensis*, and yet the tint of their yellowish markings is almost precisely the same. It therefore appears to me more likely that *saclava* formerly possessed in Madagascar, and probably also in Africa, markings of a tawny colour, and that these have been gradually changed to white on both areas as the result of a synaposematic approach to other black and white species of *Neptis*. The four outlying species did not encounter any such causes of change. According to this hypothesis the eastern species represent an early emigration when the markings of *saclava* were of a deep tawny tint, while the north-western species represent a much later phase when they were far advanced towards white. Mimetic approach commonly advances more rapidly in the female sex; and the faint cream tint of the male *saclava* may be a lingering trace of an earlier tawny shade. The difference between the pale markings of male and female is, however, so minute that a long series of fresh specimens should be compared before it can be accepted as firmly established. If the suggestion made

on p. vi that *Libythea cinyras*, Trim., is a mimic of *Neptis frobenia* be sound, it would support the conclusion that the tawny markings are of great age.

b. Changes Subsequent to Isolation.—Although it is evident that the two north-western species are specially related together, and the two eastern species also specially related, so that they represent two distinct emigrations from Madagascar, it is nevertheless true that more complete and probably far longer isolation in the outermost island has been followed by certain changes which have much in common on the two sides. In some characters the north-westernmost *N. comorarum* differs from *N. mayottensis* in much the same way that the easternmost *frobenia* differs from *dumetorum*. Both east and west of Madagascar the more remote and isolated species has undergone simplification in the details of pattern and outline, shown in a reduction of the undulations of the outline, the comparative obscurity of the marginal and submarginal pattern, and in the loss or faint development of minute details in the pattern of both surfaces, especially the under. This last effect is far more evident in *frobenia*. In one feature, however, the upper surface of *comorarum* departs further from *mayottensis* than *frobenia* from *dumetorum*, viz. in the loss of the mark on the inner margin which, in other species of the *saclava* group, prolongs the band of the hind-on to the fore-wing. This is an isolated feature; for in the retention of minute white points in the cell of the fore-wing upper surface and in the whole pattern of the under surface, *comorarum* is immensely nearer the *saclava* group than *frobenia* or even *dumetorum*.

The pronounced simplification which has occurred in the two most isolated species has been accompanied by a remarkable persistence in the larger and more conspicuous elements of the pattern, so that during flight or at rest with wings expanded, *frobenia*, at a little distance, would closely resemble *dumetorum*, and *comorarum*, under similar circumstances, *mayottensis*.

Such are the changes which have taken place in the two most isolated species of this group of *Neptis*, and it is important to separate sharply the remarkable and interesting

facts from any attempt—in this case peculiarly difficult—to explain the causes.

The minutiæ of an aposematic pattern such as that of *Neptis* may well be kept up by selection on an area where two or more species exist together, and where *e.g.* an elaboration of the marginal markings is common to all. Under these circumstances, too, elaboration would probably be gained by a species with simpler pattern brought by migration into the area in question. When, however, an aposematic species with elaborate pattern becomes isolated, we should expect, on the very same principles that are believed to account for the growth of Müllerian resemblances generally, that enemies would continue to test with especial severity large departures from the average specific pattern. But in this case the numbers composing the average, being made up of the majority of the individuals of but a single species, would exert an influence less powerful than that of the far larger number contributed by two or more species. If this reasoning be sound we should expect that a less searching selection would permit departures in minute detail, while it would still cut off large and conspicuous departures from the average. Thus, perhaps, may be explained the simplification in detail and persistence of general effect. It would furthermore follow as a general conclusion that after isolation aposematic patterns would tend to be kept more constant than others. Against this tendency must be set the special liability of aposematic species to enter fresh combinations—a tendency of course held in check in these small outlying islands.

A discussion on the change of coloration in insular forms of this and other lepidoptera followed, in which Dr. T. A. Chapman, Mr. G. A. K. Marshall, the Rev. G. Wheeler, Col. N. Manders and other Fellows participated.

Mimicry in Bourbon Butterflies.—Lieut.-Colonel N. Manders exhibited a collection of butterflies from Bourbon demonstrating examples of mimicry and the effects of the interaction of species. At a previous meeting of the Society he had exhibited a series of the *nireus* group of Papilios from Africa, Madagascar and the neighbouring islands, in which he pointed out that whereas both sexes were of some shade of green

and therefore resembled each other, in Bourbon the female of the indigenous species (*P. phorbanta*) was brown and quite unlike the male. He attributed this to the effects of mimicry, *Euploea goudoti* being the model. It had since been suggested to him by Professor Poulton and Mr. Trimen that *Euplœa euphon* resembled both *P. phorbanta* and *Salamis augustina* far more closely than *E. goudoti*, and they were of opinion that this had been the model for the two species. Against this view was the fact that *E. euphon* was strictly confined to Mauritius, and no record of its occurrence in Bourbon was forthcoming. This undoubtedly closer resemblance of *euphon* had led him to further investigate the matter, and there appeared to be two hypotheses to account for its disappearance: either *goudoti* was a modified descendant of *euphon*, or in some way it had replaced it. With regard to the first point he showed essential differences between the two; *goudoti* being more closely connected with that group of *Euplœas* placed by Moore in the genus *Vadebra*, and *euphon* with those in his genus *Nipara*. He then discussed the possibly Malayan origin of *goudoti*, and remarked more particularly on its extraordinary resemblance to *E. woodfordi* from the Solomon Islands, and expressed the opinion that all the *Euplœas* of this group were derived from the same ancestral type, and suggested *E. climena* from Amboina and Ceram as being nearest to it. He dealt with the former history of Mauritius and Bourbon, and explained that both during the Dutch and French occupation in the seventeenth and eighteenth centuries a large number of Malayan plants were introduced into those islands, and that inasmuch as the voyage from Java was only of three weeks to a month's duration, there was no inherent improbability of *E. goudoti* being brought to Bourbon by one of the Dutch or French ships. He concluded by describing the physical characteristics of the island, and said that the area favourable for the existence of *Euplœas* was extremely small, and as the larvæ of *goudoti* and *euphon* fed on the same plants there was in all probability a struggle for existence set up in which the invader proved the stronger and eventually exterminated its rival.

Professor Poulton desired to congratulate Colonel Manders

for the careful manner in which he had worked up the evidence bearing upon his brilliant suggestion. As one who had arrived at an alternative interpretation—viz. that *goudoti* represented a recent modification of *euphone* in the island of Bourbon—he desired to express his agreement with Colonel Manders, and his conviction that the most probable solution of a puzzling set of facts had been afforded by the hypothesis he had so clearly explained to them that evening. He also remarked that in the neighbouring island of Rodriguez there was a species of *Euplœa* (*desjardinsi*) greatly resembling *euphon*, and no doubt a geographical race of that species. This fact, he considered, also suggested that *euphon* formerly existed in Bourbon.

Food of Glow-worm.—Mr. W. J. Lucas showed a larval glow-worm found at Oxshott on May 4, inside the shell of the snail *Helix cantiana*. There was no doubt that the larva was feeding on the snail, for on breaking away parts of the shell the moist remains of it were found near the apex.

Types of Oxygastra.—Mr. Lucas also brought for exhibition the ♂, ♀, and nymph of the dragonfly *Oxygastra curtisii*, first described by the late J. C. Dale, and at that time supposed to be confined to the British Islands.

Rare British Beetle.—Mr. H. St. J. Donisthorpe showed an example of the rare beetle *Xantholinus distans*, Kr., taken at Helton, near Dumfries, on May 1.

Papers.

Mr. W. J. Lucas, B.A., read a paper on "The British Dragonflies of the 'Dale Collection.'"

Dr. T. A. Chapman, M.D., F.Z.S., read a paper on "The Distinctness of Several Species of *Everes*, determined by their Genitalia," and exhibited photographs to illustrate his remarks. He announced that as the result of his investigations *Everes argiades*, Pall., and the so-called var. *coretas* were separate, though very nearly allied species.

Friday, May 15th, 1908.

CONVERSAZIONE

(in the rooms of the Civil Service Commission, Burlington Gardens, W.)

THE Fellows, and guests to the number of about 300, were received by the President, Miss WATERHOUSE, Professor E. B. POULTON, F.R.S., and Mr. H. ROWLAND-BROWN, Secretary and Vice-President.

In the Large Room the following exhibitions were shown :—

1. Professor E. B. POULTON, F.R.S. Mimicry in American Papilios.

1A. Col. D. BRUCE, F.R.S. Microscopic preparations to illustrate the Entomological Aspects of the Sleeping Sickness.

2. Lt.-Col. N. MANDERS, R.A.M.C. Series of *Melanitis leda* taken at different seasons.

3. Dr. G. B. LONGSTAFF. Plants of *Bryophyllum calycinum*, a favourite resting place of *Callidryas eubule*.

Rest attitudes of Butterflies.
Flies mimicking Wasps.
Water-Grasshoppers.

3A. Dr. F. A. DIXEY and Dr. G. B. LONGSTAFF. Scents in Butterflies.

4. The PRESIDENT. Illustrations of Tsetse and other biting Flies.

5. Mr. E. A. BUTLER. Dimorphism in Hemiptera, and recent additions to the British List.

6. Mr. R. SHELFORD. Insects preserved in Amber.

7. Lt.-Col. C. T. BINGHAM. Nest of Wasp from Assam, with occupant attacking spider.

8. Mr. H. J. ELWES, F.R.S. Variation and Dimorphism in Indo-Chinese and Indo-Malayan Butterflies.

9. Mr. W. J. KAYE. Heliconine Butterflies from British Guiana.

10. Mr. W. F. ROSENBERG. Rare Heterocera from South America.

11. Mr. H. Eltringham. Mimicry in African Butterflies.

12. Mr. O. E. Janson. Goliath Beetles.

13. Dr. H. C. Phillips. Parasites on Lepidoptera.

14. Mr. G. T. Porritt. Melanism in West Yorkshire Lepidoptera.

15. Mr. C. P. Pickett. British Lepidoptera.

16. Mr. L. W. Newman. Living British Larvæ and Pupæ.

17. Mr. A. Sich. Lepidoptera of South London.

18. Mr. Selwyn Image. Lepidoptera observed within six miles of Charing Cross.

19. Mr. R. Adkin. Local Variation in a common British species.

20. Mr. S. J. Capper. Drawings by Mr. S. L. Mosley of varieties of British Lepidoptera.

21. Dr. H. C. Phillips. Drawings of Butterfly Subjects.

22. Mr. Selwyn Image (for Mr. Christopher Whall). Drawings by Miss Garnet of Coleophorid species.

23. Mr. A. H. Jones. The Genus *Anthocharis*.

24. Miss M. E. Fountaine. Spring Butterflies of the Mediterranean Region.

25. The Rev. G. Wheeler. Rare and variable species of Swiss Butterflies.

26. Dr. T. A. Chapman. Homœochromatism in French Butterflies.

27. The Obligation Book of the Entomological Society of London with the signatures of the Duchess of Kent and the Princess Victoria, afterwards Queen Victoria.

28. Mr. A. W. Bacot. *Malacosoma neustria* and *M. castrensis*, and their hybrid forms.

29. Mr. L. B. Prout and Mr. A. W. Bacot. Experiments in Mendelian Heredity with *Acidalia virgularia*.

30. Mr. A. Hall and Mr. C. J. Grist. Mimetic Nymphaline Butterflies and their Models.

31. Mr. S. Edwards. Morphos.

32. Mr. J. A. Clark. Varieties of *Peronea cristana*.

33. Mr. R. South. Aberrations of *Peronea cristana* and *P. hastiana*.

34. Mr. H. St. J. Donisthorpe. Insects and other forms associated with British Ants.

The British Ants.

Observation nests of *Formica rufa* and *F. sanguinea*.

35. Mr. A. Harrison and Mr. H. Main. Local forms and varieties of *Pieris napi* and *Aplecta nebulosa*.

36. Mr. A. E. Tonge. Stereoscopic Photographs from nature.

37. Mr. H. J. Turner. Life Histories of the genus *Coleophora*.

38. Mr. E. B. Nevinson. British Aculeate Hymenoptera.

39. Mr. H. Main. Photographs of Lepidoptera.

40. Mr. F. Enock. Microscopic demonstrations.

In the small room microscopic demonstrations were given during the evening by the following firms:—Messrs. R. and J. Beck, Ltd., Messrs. Ross, Ltd. and Mr. Charles Baker.

In the Theatre Mr. H. St. J. Donisthorpe delivered an address on "The Inhabitants of Ants' Nests in Britain," and Col. D. Bruce, C.B., F.R.S., on "The Entomological Aspects of the Sleeping Sickness."

In the Large Hall, where refreshments were served, the Aeolian Ladies' Orchestra performed a selection of music under the direction of Miss Rosabel Watson.

Wednesday, June 3rd, 1908.

Mr. H. Rowland-Brown, M.A., Vice-President, in the Chair.

Exhibitions.

Pseudogynes of an Ant.—Mr. H. St. J. Donisthorpe brought for exhibition pseudogynes of *Formica sanguinea*, caused by the presence of the beetle *Lomechusa strumosa* in the nest, from the New Forest. Professor E. B. Poulton said that corresponding forms of an ant had been found in North America caused by the presence of a corresponding beetle in the nest.

Living Coleophorid, and Asilid with Prey.—Mr. H. J. Turner showed living larvæ of *Coleophora maritimella* on *Artemisia*, and also a species of *Asilidæ* and its prey.

Leaf Insects from Seychelles.—Mr. C. J. Gahan exhibited

living specimens of a "leaf-insect" from the Seychelles, bred in England by Mr. St. Quintin, probably *Pulchriphyllium crurifolium*, Serville. Mr. Meade-Waldo stated that these insects were brought originally from the Seychelles by Lord Crawford, and that those exhibited belonged to the second generation.

Lampyridæ from Ceylon.—Mr. Gahan also exhibited some *Lampyridæ* of considerable interest collected by Mr. E. E. Green in Ceylon, and including both sexes of the genera *Lamprigera* and *Dioptoma*, the females of which had hitherto been unknown. The females of both genera were larviform; that of *Lamprigera* resembled in form the larva of the same genus, but differed in the greater development of the antennæ and tarsi, the former being 6 to 7-jointed and the latter 3 or 4-jointed; the eyes were, however, simple as in the larva. The female of *Dioptoma* had a general resemblance to the female of *Drilus flavescens*, but was furnished with a very distinct photogenic organ, as evidenced by the large, bright yellow sternal plate of the seventh abdominal segment; the eyes were facetted, emarginate behind as in the male but much smaller in size; the antennæ were 12-jointed and the tarsi 5-jointed. He showed also a larviform insect, probably an adult female, which he had found to be full of eggs. This insect was of the same general type as those remarkable trilobitiform insects, described by Perty, Westwood and others, and which had generally been regarded as the larvæ of *Lycidæ* or *Lampyridæ*. Like these it had large spiracles on the methathorax. He called attention also to the existence in China, Ceylon and the Malay Peninsula of remarkable larviform females greatly resembling the females of the American group *Phengodini*, and being somewhat similarly provided with rows of luminous points. The males of these forms were not yet identified, but he suspected they would prove to belong to genera at present referred to the family *Drilidæ*.

Mr. R. Shelford remarked that in several of the Malacoderm Coleoptera from the Malay Archipelago regarded as larval or apterous forms, the males and females were indistinguishable, and underwent practically no metamorphosis.

Rare and Blind Beetles.—Mr. G. C. Champion exhibited specimens of *Dromius angustus*, Brullé, and *Cryptophagus lǿvendali*, Ganglb., recently recorded by him from Woking and the New Forest respectively; also two species of the Staphylinid genus *Leptotyphlus* and one of the Curculionid genus *Alaocyba*, calling attention to the fact that these extremely minute blind South-European insects were much smaller than any known British representatives of the groups in question.

Rhopalocera from the Canaries.—Col. C. Swinhoe exhibited several boxes of butterflies taken by him during the present year (1908) in the Canary Islands, chiefly from Grand Canary and Teneriffe. They included amongst others *Pieris rapæ* showing a tendency to lose the black spots on the upper sides of the wings, *P. brassicæ* var. *cheiranthi*, Hb., *P. daplidice*, *Gonopteryx cleobule*, *Chrysophanus phlæas*, *Vanessa atalanta* (a rare species in the islands), *V. indica*, var. *vulcania*, Godt. (common), *Pyrameis cardui*, *Colias edusa*, *Argynnis pandora*, *A. lathonia*, *Pararge xiphia*, var. *xiphioides*, Stgr., *Epinephele jurtina*, var. *hispulla*, and *Lampides webbianus*, the one butterfly peculiar to the islands. He observed that with the exception of the last-mentioned all the species met with suggest a foreign origin.

Papers.

Mr. J. E. Collin communicated "Notes on the value of the Genitalia of Insects as guides in Phylogeny," by Mr. W. Wesché, F.R.M.S.

Dr. D. Sharp, M.A., F.R.S., communicated a paper "On certain *Nycteribiidæ*, with descriptions of two new species from Formosa," by Mr. Hugh Scott, B.A. (Cantab).

Dr. J. L. Hancock, M.D., communicated a paper on "Further studies of the *Tetriginæ* (Orthoptera) in the Oxford University Museum."

Mr. J. C. Moulton read a paper on "Mimicry in Tropical American Butterflies."

Professor E. B. Poulton, F.R.S., read a paper on "Heredity in *Papilio dardanus* from Natal, bred by Mr. G. F. Leigh, F.E.S., of Durban," and exhibited, in illustration, a large series of the forms of *P. dardanus* from Natal and Chirinda.

Mr. Hamilton H. Druce, F.L.S., read a paper on "New species of Hesperiidæ from Central and S. America," and exhibited the specimens described; also a series of the sub-family *Pyrrhopyginæ*, together with the genus *Erycides* of the sub-family *Hesperiinæ* showing the great similarity of some of the species with those of the *Pyrrhopygine* genus *Jemadia*, and also pointed out that the sub-family *Pamphilinæ* contained genera with species again almost exact copies of those shown in the two previously mentioned sub-families.

Dr. G. B. Longstaff, M.D., called the attention of Fellows to a very interesting paper on "The Life History of House Flies," by Dr. A. Griffith, M.D., D.P.H., in the monthly publication "Public Health."

Conversazione.

The Vice-President made a statement relative to the expenses of the Conversazione, and informed Fellows who had kindly placed their names on the Guarantee Fund list that they would be asked to pay a contribution not exceeding 5*s.* 4*d.* in the pound.

Mr. F. Merrifield proposed a vote of thanks to the Fellows who had been chiefly instrumental in making the Conversazione a success, and the Vice-President begged to be allowed to mention in particular the services rendered by Mr. R. Adkin and Mr. Stanley Edwards, who had undertaken the whole work of arrangement in connection with the exhibitions.

The vote of thanks was given unanimously.

Wednesday, October 7th, 1908.

Mr. C. O. Waterhouse, President, in the chair.

Election of Fellows.

Mr. James J. Joicey, of 62 Finchley Road, London, N.W., and Mr. Robert M. Prideaux, of Woodlands, Brasted Chart, Sevenoaks, were elected Fellows of the Society.

Obituary.

The decease was announced of Mr. T. Maddison.

Oxford University Museum Jubilee

It was announced that the Society would be represented by Commander J. J. Walker, R.N., M.A., F.L.S., at the Celebration of the Fiftieth Anniversary of Oxford University Museum, on October 8th.

Exhibitions.

Mimicry of the *melpomene*-like *Heliconii* by other groups of South American Butterflies.—Dr. F. A. Dixey exhibited specimens of Neotropical butterflies belonging to the Erycinidæ, Acræinæ, Heliconinæ, Nymphalinæ, Pierinæ and Papilioninæ, and remarked upon them as follows:—

"On March 18 last, Mr. W. J. Kaye, in exhibiting three species of the Pierine genus *Pereute*, together with specimens of the Nymphaline *Adelpha lara*, Hew., called attention to the fact that these species, which all bear a general resemblance to each other, are found together in the Chancamayo district of Peru at an elevation of from 2500 to 3000 feet. He added that it was wrong to suppose that any *Heliconius* of the *melpomene*-like group entered the combination, inasmuch as *Heliconii* of this pattern did not ascend to such an elevation, or if they did, it was only as a rare exception. For the like reason Mr. Kaye thought that my suggestion, made in 1896 (and previously in 1894), of an association between *P. leucodrosime* and *H. melpomene* was 'an impossible conclusion.'

"I am of course perfectly ready to accept the testimony

brought forward by Mr. Kaye as to the spatial relations of these forms in the district named, but I observe with interest that in a note to the record of his exhibition in our recently-published 'Proceedings' (Proc. Ent. Soc. Lond., 1908, p. xxiii), he mentions the fact that according to Seitz, 'in Colombia *Pereute leucodrosime*, *Papilio euterpinus*, *Adelpha isis* and *Heliconius melpomene* all occur together on the same bush.' This obviously discounts the value of the observations made in Peru, considered as evidence of the exclusion of *Heliconius* from the mimetic combination. No stress need be laid on the mention of *H. melpomene* instead of one of the forms which so closely resemble it, as for instance *H. hydarus*, inasmuch as before the publication of Riffarth and Stichel's excellent systematic work on the genus, many of the *melpomene*-like forms were but vaguely distinguished from one another; and even now it is very probable that by those who do not happen to have made a special study of the genus, forms are inadvertently spoken of as *melpomene* which are really quite distinct from that species as at present defined. In 1896 I used *H. melpomene* as an illustration; but in the earlier passage then referred to, I spoke of the resemblance as being shared by many species of *Heliconius*, including *H. hydarus* (Trans. Ent. Soc. Lond., 1894, p. 294 and note; ibid., 1896, pp. 72–75). The argument, whatever it may be worth, would of course remain unaffected even if it were shown that species had been wrongly identified.

"But leaving this part of the question, I wish to draw attention to the very wide prevalence of this general type of pattern (a dark wing-surface crossed by a diagonal reddish band) in the Neotropical region, as exemplified by the specimens I now exhibit. Opinions may differ as to how far these various forms are in mimetic relation; that such a relation exists between some at least of them will I think be generally admitted. For instance, the mimetic parallelism between the two sections of *Heliconius*, which Mr. Kaye has so fully demonstrated to us (Proc. Ent. Soc. Lond., 1907, pp. xiv–xvi), seems to be undeniable. The relation also between the *Papilio* and the Pierines in this exhibit can scarcely be doubted. It is true that the latter combination, which, as Mr. Kaye says, is

no doubt mainly an upland assemblage, falls somewhat apart in aspect from the *melpomene*-like *Heliconii*, but it is to be observed that the latter are not entirely confined to the lowlands. Two species from Ecuador here shown (*H. vulcanus* and *H. cyrbia*) are from series captured at an elevation of 3500 feet, which is quite high enough for any *Pereute*. Still more important is the fact that many other forms are seen to exist which may very well bind together the inhabitants of the heights and of the plains in one mimetic assemblage; the *Catagrammas*, for instance, are stated to occur at all elevations. Another fact to be borne in mind is that the distribution and movements of the enemies have to be taken into account as well as those of their prey; and until we know for certain that these enemies are similarly limited in their range, we cannot well exclude the possibility of the extension of the mimetic influence of a given species beyond its own area of distribution

"It may be remarked, in conclusion, that the 'aposeme' shades off in various directions; one of them being probably exemplified by the Erycinids exhibited, and another by the *Actinotes*."

The species shown were—

ERYCINIDÆ.

Erycina inca, Saund.	Panama.
Panara phereclus, Linn.	Brazil.
Aricoris, sp.	

ACRÆINÆ.

Actinote stratonice, Latr.	Colombia.
A. trinacria, Hew.	Ecuador.

HELICONINÆ.

A. *Heliconius amaryllis*, Feld.	
euryades, Riff.	Trinidad, Venezuela, Colombia, Peru.
H. melpomene, Linn.	Guiana, Amazon, Peru, Ecuador.
H. vulcanus, Butl.	
cythera, Hew.	Ecuador.
B. *H. hydarus*, Hew.	
guaricus, Reak.	Colombia, Venezuela.

H. hydarus, Hew.	Trinidad, Central America, Colombia.
H. erato, Linn. *magnificus*, Riff.	Guiana, Peru, Ecuador.
H. amphitrite, Riff.	Peru.
H. cyrbia, Godt.	Ecuador.

NYMPHALINÆ.

Catagramma denina, Hew.	Guatemala to Ecuador.
C. pasithea, Hew.	Peru.
C. eunomia, Hew.	Amazon.
C. parima, Hew.	Colombia, Ecuador.
Adelpha lara, Hew.	Colombia, Peru.
Eresia castilla, Feld.	Colombia, Ecuador.
Agrias amydon, Hew.	Colombia.

PIERINÆ.

Pereute charops, Boisd. ♀.	Central America, Colombia, Ecuador.
P. callinice, Feld.	Colombia.
Catasticta teutamis, Hew. ♀.	Ecuador, Peru.

PAPILIONINÆ.

Papilio euterpinus, Godm. and Salv.	Colombia, Ecuador.

C. teutamis ♀ and *P. euterpinus* were represented by coloured drawings.

BUTTERFLIES FROM SOUTH SPAIN.—Mr. W. G. SHELDON brought for exhibition a case containing butterflies from Andalusia taken in the spring of this year. They included *Anthocharis belemia* and var. *glauce; A. tagis*, low-level and high-level forms, with *A. tagis*, var. *bellezina*, from Digne, for comparison; *Zegris eupheme*, var. *meridionalis; Melitæa phœbe*, var. *occitanica; M. deione*, a very large and well-marked form; *Melanargia ines*, with one striking aberration showing a strong melanic tendency; and large bright *Nomiades melanops*, with French specimens for comparison.

ABERRATION OF DRYAS PAPHIA.—DR. HERBERT CHARLES showed a remarkable aberration of *Dryas paphia* taken by him in the New Forest in July last. With the exception of the borders, and the bases, the wing surfaces were suffused with

deep velvety brown triangular patches, the maculations being entirely absorbed therein.

Living Larvæ of Blatta.—Mr. Hugh Main showed living larvæ of *Blatta germanica* to illustrate their colourless condition on first emergence.

Rare British Beetles and dipterous parasites.—Mr. H. St. J. Donisthorpe exhibited examples of (*a*) *Agrilus biguttatus*, F., taken in numbers in bark of old oak in Sherwood Forest, July 1908. It had not been taken in Britain for about thirty years, this being the first record for the Midlands. Formerly it occurred in Darenth Wood, but is not found there now; (*b*) *Pyropterus affinis*, not uncommon in Sherwood Forest, July 1908; (*c*) a species of *Phora*, with pupæ bred from larvæ which came out of the body of a *Clerus formicarius* taken alive in Sherwood Forest, July 1908, with the *Agrilus*, and probably parasitic on it; (*d*) *Trogolinus anglicanus*, Shp., a specimen taken at Bembridge, August 3rd, 1908, with a specimen from Plymouth, and only known before to occur in New Zealand and at Plymouth, where it was discovered by Mr. Keys. This capture seemed to dispose of the idea that it could have been introduced from New Zealand; (*e*) *Phyto melanocephala*, Mg., bred from wood-lice taken at Bembridge, I. of W., August 1908, with pupæ, and a wood-louse with dipterous pupa *in situ*. The life-history of fly was hitherto unknown, though the larvæ of *Rhinophora atramentaria*, Mg., a nearly related species, have been recorded as parasitic on *Oniscus asellus*.

Gynandromorphous pieris.—Mr. A. Harrison exhibited a gynandromorphous example of *Pieris napi*, bred from parents taken in North Cornwall this year.

Rare British Neuroptera.—Mr. E. R. Speyer exhibited a case of rare and interesting dragonflies taken in the British Isles in 1908, including (*a*) *Sympetrum fonscolombii*, Selys. A ♂ and ♀, taken in Hertfordshire on June 24th and July 27th respectively. The specimens were evidently part of a migration, the ♀, being the first taken in England, since that announced by Mr. Boyd in Cornwall in the E. M. M. Vol. 39, p. 201 (1903). Mr. K. J. Morton is of opinion that the insect takes more than a year to arrive at maturity, and, therefore, those taken in England are probably in their second

year; (*b*) *Somatochlora metallica*, Lind., a ♂ captured in Sussex on August 4th, being the first authentic record of this insect in England. Dr. Buchanan White discovered the insect in Scotland in 1869, and Mr. J. King of Glasgow took it again in 1899 in the same locality. Whether the specimens observed in Sussex were migratory or not, has still to be determined, but at the end of August several ♀ ♀s were seen, one of which was evidently ovipositing; (*c*) *Anax imperator*, Leach, a ♂ caught in Hertfordshire on June 24th with *Libellula depressa*, ♂, in its jaws; (*d*) *Libellula depressa*, Linn., two ♀ ♀s taken late in the season, showing the appearance of blue powder on the abdomen; (*e*) *Libellula quadrimaculata*, Linn., four specimens; two taken in Sussex, showing the remarkable difference in the amount of suffusion on the wings in individuals from the same locality: the other two from widely different localities, one from North Wales showing great, and one from Ventnor, Isle of Wight, showing very little wing-suffusion, proving that the supposition that specimens from the north have much less wing-suffusion than those from the south, and *vice versâ*, is unfounded. The greatly suffused specimen from Sussex had no black suffusion under the pterostigma, which is normal: the specimen from the Isle of Wight was caught by Sir W. Parker.

The case also contained the following insects :—

Orthetrum cancellatum, Linn., ♂ and ♀, from Herts; *Cordulia ænea*, Linn., ♂, from Burnham Beeches, Bucks; *Brachytron pratense*, Müll., ♂ and ♀, from Oxford; *Platycnemis pennipes*, Pall., ♂ and ♀, var. *lactea*, from Oxford; *Erythromma naias*, Hansen; specimens from Herts, Bucks, Sussex; and *Pyrrhosoma tenellum*, Linn., ♂ and ♀, from Sussex.

New and rare British Beetles.—Mr. Norman Joy exhibited examples of Coleoptera new to the British list, including *Oxypoda perplexa*, Muls., Cornwall; *Sunius lyonessius*, Joy, Scilly Isles; *Anisotoma flavicornis*, Bris., Bradfield; *Melanophthalma truncatella*, Mannh., Norfolk; *Cryptophagus hirtulus*, Kr., Scilly Isles; *Litaryus coloratus*, Rosenh., Sherwood; *Corticaria linearis*, Payk., Bradfield; *C. longicollis*, Zett., Epping; and *Longitarsus nigerrimus*, Gyll., Cleethorpes.

Rare British Neuroptera.—Mr. H. M. Edelsten showed

specimens of *Æschna isosceles* and *Libellula fulva* from Norfolk Broads, taken in June last, and *Orthetrum cærulescens* from Chagford, taken in July.

Parasites on Flies.—Mr. W. J. Lucas exhibited a spike of the grass *Molinia cærulea* with dead Syrphids, *Melanostoma scalare*, Fabr., attacked by the parasitic fungus *Empusa muscæ*, found on Esher Common, October 3rd, 1908. Most were attached by the point of the head only in a very peculiar manner, and apparently all were females.

Cryptamorpha desjardinsi in Hampshire.—Mr. O. E. Janson exhibited a specimen of *Cryptamorpha desjardinsi*, Guér., found by Mr. F. C. Selous running on a table-cloth in his house at Barton-on-Sea, Hants, on June 26th. This beetle is recorded as living in banana plants in Mauritius and Madeira, and may have been introduced here in the banana fruit.

Mr. H. St. J. Donisthorpe said that Mr. Bagnall had found this species in the cellar of his house at Winlaton-on-Tyne. Commander J. J. Walker reported having taken it in the sheathing leaves of a banana in Kawau Island, New Zealand, and Mr. G. C. Champion remarked that it was probably imported among the dry leaves of the banana, not in the fruit, as he had found various species of the allied genus *Telephanus* in the pendent leaves of Musaceous plants in Central America.

Rare British Coleoptera and Hemiptera.—Mr. G. C. Champion, on behalf of Mr. W. West, who was present as a visitor, exhibited specimens of the following insects : *Aleochara crassiuscula*, Sahlb., taken at Gt. Yarmouth in May 1908 ; varieties of *Donacia dentipes* and *D. simplex*, from Caistor Marshes ; *Nabis boops*, Schiödte, taken at Esher, in August 1908 ; and *Idiocerus scurra*, Germ., taken at Blackheath, Kent, in September 1908.

Rare and Variant British Heterocera.—Mr. L. W. Newman brought for exhibition specimens of (*a*) *Crymodes exulis* from the Shetlands, including one female. The ♀ of this species is very rare, and until this season (when some six or seven were taken) only a very few were known. One ♂ exhibited was of the rich dark brown form while the rest were

the light brown form; (*b*) *Callimorpha dominula*, two yellow aberrations bred from East Kent ova. In 1906 a yellow ♀ was bred. This was paired with a typical *red* ♂ and the result in 1907 was that the whole brood were typical *Reds*. These *Reds* were paired, and in 1908 the brood (a small one) produced 25 per cent. of the yellow form; (*c*) *Camptogramma fluviata*, a varied series bred from ova laid by a ♀ taken at Eastbourne, the most remarkable specimens being a ♂ with the band broken in the centre, a ♂ with the band entirely wanting, and a ♀ devoid of the usual orbicular spot; (*d*) a yellow aberration of *Noctua rubi*, from Yorkshire.

Papers.

Dr. G. B. Longstaff, M.D., read a paper on "Bionomics of Butterflies."

Mr. L. J. Hare, F.E.S., communicated a paper on "Some additions to the *Perlidæ*, *Neuroptera-Planipennia* and *Trichoptera* of New Zealand."

Mr. Roland Trimen, F.R.S., communicated a paper "On the larvæ of *Hamanumida dædalus*, Fab., *Hoplitis phyllocampa*, n. sp., and *Eulophonotus myrmeleon*, Feld., with descriptions of the imagines of the two Heterocera."

Mr. A. M. Lea, F.E.S., Government Entomologist, Tasmania, communicated "A revision of the Australian and Tasmanian *Malacodermata*."

Wednesday, October 21st, 1908.

Mr. C. O. Waterhouse, President, in the Chair.

Election of an Honorary Fellow.

Monsieur Charles Oberthür, of Rennes, France, was elected an Honorary Fellow of the Society.

Election of Fellows.

Mr. Charles B. Antram, of the Insectarium, Kanny Koory, Silchar, P.O., Cachar, Entomologist to the Indian Tea Association; and Mr. Richard Beck, Sanderhayes, Bitterne Road, Southampton, were elected Fellows of the Society.

Obituary.

The decease was announced of Lieut.-Colonel Charles T. Bingham, F.Z.S., a Fellow of the Society, and the Secretary was asked to convey to Mrs. Bingham a message of sympathy from the Society.

Exhibitions.

Rare Beetle at Purley.—Mr. E. C. Bedwell exhibited examples of the rare Lamellicorn beetle *Gnorimus variabilis*, L., found by him in thick frass under the bark of old oaks, near Purley Oaks, Surrey, in the larval state, in May last, and again as imagines in the same locality in the following month. He described the species as one becoming extinct in the United Kingdom, when the President said it had been reported from Windsor Forest in 1892.

Abnormal Pytho depressus.—Mr. G. C. Champion showed a specimen of *Pytho depressus*, L., with two tarsi to the right hind-leg. It was bred from a larva or pupa found under pine-bark at Binn, Switzerland, and the abnormal growth may have been due to the attacks of other larvæ kept in the same box.

Forms of Thais.—Mr. W. G. Sheldon exhibited a case containing several forms of *Thais rumina*, the var. *medesicaste*, and the ab. *canteneri*, Hey., from South Spain, and from France.

Wing suffusion of Libellula.—Mr. W. J. Lucas brought for exhibition a set of eight examples of *Libellula quadrimaculata* from Scotland, and the South of England, to illustrate the range from the type form to the var. *prænubila* of Newman. The variation takes two lines, one the development of the blackish suffusion beneath the nodes and pterstigma; secondly, a saffron suffusion parallel to the costa.

Mr. H. M. Edelsten also showed a varied series of the same dragonflies from the Norfolk Broads.

Aberrant Dryas paphia.—Mr. L. W. Newman exhibited paintings of two forms of *Dryas paphia* bred by him this season from ova of parents taken at Brockenhurst, generally resembling the aberration of this butterfly shown by Dr. Herbert Charles at the last meeting.

Professor E. B. Poulton, F.R.S., enquired as to the means by which the young larvæ were brought through the winter.

The method employed was somewhat complicated, and Mr. Newman subsequently prepared the following account which, it is believed, will be of service to Fellows of the Society and other naturalists who desire to test the application of Mendel's Law to forms with hybernating larvæ, such as the *valezina* var. of the female *D. paphia*.

Hints as to the Egg-laying and Hybernation of Larvæ of D. Paphia.—The female butterflies are confined in cheese-tubs: in each of these I place a spray of flowers which is kept sprinkled with honey and water made into a syrup. Round the inside of the tubs are pieces of rough bark, and over the top mosquito netting. In nature the females of *paphia* often lay their eggs on the bark of trees; for the young larvæ hybernate without feeding in the autumn and consequently at once require a safe and *dry* place in which to pass the winter. In captivity the females lay freely on the bark I place in the tubs and on the mosquito netting. The eggs change colour quickly, and the young larvæ hatch in about fourteen days. Just before the larvæ hatch, I take the bark out of the tubs and place it in large glass-topped metal boxes which I have specially made for the purpose. On the top of the bark I place a layer of fine "wood wool," such as is used for packing. Many of the young larvæ crawl into the crevices of the bark, while others affix themselves to the "wood wool." The eggs laid on the mosquito netting are treated in the same manner, the netting being lightly rolled up and placed in the bottom of the glass-topped boxes and wood wool over it. The metal boxes are then stored away on the stone floor of a cold greenhouse till the spring. As a rule the larvæ are on the move about mid-February: I then remove the lids and stand the boxes on their sides in huge cages, 14 to 20 ft. long and 4 to 8 ft. broad, planted with growing violets. When the larvæ require food they crawl out of their winter home, and at once find food close at hand. The metal boxes should be as large as possible. Those I am now using are 6 in. deep and 12 in. in circumference, and I wish they were four times as large. This year I am employing large

bottles for the purpose. The violet cages or frames are covered with glass when placed in a cool greenhouse, with perforated zinc when out of doors. I have also used for the latter a removable top covered with mosquito netting. This can be stored during the winter to preserve it from rotting. The larvæ seem to do better, and certainly feed up much faster in the greenhouse.

I should mention all my out-of-doors cages are built on water to exclude vermin; first I build a huge table with six to nine legs, these legs each stand in a bucket which is well tarred and filled with water, then on the top of this table I build up the cage.

I have had plenty of *valezina* sent me and have bred from them a fair percentage of this variety, but no intermediate forms.

Colour derivation of Leucothyris zelica.—Mr. W. J. Kaye showed a synaposematic series of specimens from Ecuador comprising *Ithomiinæ* and *Pierinæ*. Of the former there were *Dircenna zavaletta* 5 ♂ 2 ♀, and *Leucothyris zelica* 14 ♂ 0 ♀. Of the latter there were *Dismorphia othöe* 15 ♂ 6 ♀, *Dismorphia leuconia*, 7 ♂ 1 ♀, and *Dismorphia* sp.?, 4 ♀. The whole of these specimens had been purchased unset in a parcel of papered specimens, and information as to exact locality and whether any specimens of these species had been previously removed was unfortunately wanting.

Mr. Kaye pointed out that the usual coloration of *Leucothyris* species was black and transparent, but here was one, *L. zelica*, which was yellow, and the significant fact illustrated by the exhibit was that there were in the aggregate more Pierines than Ithomiines, and taking *L. zelica* alone there were only 14 specimens to the 33 of the associated *Dismorphias*. It appeared therefore to be quite possible that the *L. zelica* obtained its yellow colouring by the association with the Pierines and played the part of mimic instead of model.

Oviposition of a Leucania.—Mr. H. M. Edelsten exhibited a tube containing ova of *Leucania brevilinea, in situ*, laid within the sheathing leaf of a dead reed-stem found in Norfolk in July 1908.

Forms of Aplecta nebulosa.—Mr. A. Harrison showed numerous examples of *Aplecta nebulosa*, of the form *robsoni*,

bred from parents taken in Delamere Forest. He said that the proportion in breeding was as follows:—grey form, 25 %; var. *robsoni*, 51 %; and var. *thompsoni*, 24 %.

Vosges, and aberrant British Butterflies.—Mr. A. E. Gibbs brought for exhibition a case containing (*a*) a series of *Everes argiades*, taken this year at various altitudes in the Vosges region, showing a fine large form; (*b*) *Lycæna bellargus*, a ♀ from South Devon, with the wings on the left side, especially the secondary, splashed and streaked with male colorations; (*c*) *Lycæna icarus*, ♂, also taken in South Devon, measuring only 19 mm. in expanse; and (*d*) an example of *Chrysophanus phlæas*, approaching on the right side ab. *schmidtii*; the ground colour of the primary being silvery-white, with the exception of a broad streak of copper colour extending from the base of the wing, where it is widest to the transverse row of black spots: hind-wings slightly caudated; taken at Harpenden, Herts, by a schoolboy, August 11th, 1906.

Forms of Erebia and Lycæna from Germany.—Mr. E. M. Dadd exhibited specimens of *Erebia ligea* from various German localities, amongst others from Neundorf in the Glazer Geberge, where a small series of *E. euryale* was also obtained. This latter species is said to differ from *E. ligea* in being smaller, in having no white pupils to the black spots, and further in showing scarcely any white on the under sides of the hind-wings. Although all specimens taken had four spots on the fore-wings, it is said to sometimes have three. Also a short series of the forms *ocellaris*, and *extrema* collected by Mr. Esselbach at San Martino di Carozza among typical var. *adyte*.

The forms *ocellaris* and *extrema* are referred to in Staudinger's catalogue, as also the new work by Seitz, to *euryale*; the form *adyte* to *ligea*. Both these forms have only three spots on the fore-wings, only one single female out of over one hundred specimens of *adyte* in the exhibitor's collection having a faint indication of the fourth spot. With regard to the examples shown of *adyte* taken at Zermatt and Pontresina, among the Pontresina *adyte* was a single specimen which might be placed amongst the *ocellaris* without the slightest hesitation;

although not quite so dark as any of them. The exhibit also included one specimen of the form *euryaloides* which is accredited to *euryale* in both the above-mentioned works, occurring with the *adyte* at Pontresina.

Mr. Dadd said that as far as he knew the form of *euryale* with four spots did not occur at Pontresina although *adyte* was in abundance everywhere. He suggested as a result of these observations that the facts point to one of two things: Either all these forms were forms of one species; or if any division were to be made, it should be by drawing the four-spotted forms *ligea* and *euryale* together and raising the three-spotted form *adyte* to the rank of a species with the forms *ocellaris*, and *extrema* and *euryaloides* as sub-forms.

In the Glazer Geberge, where the two first-named occurred, *E. ligea* was found on the lower levels and *E. euryale* much higher up.

Mr. Dadd also exhibited forms of *Lycæna corydon* from various localities: (*a*) a typical series from England, and the Thüringer Wald; (*b*) var. *apennina* from the Sabine mountains; (*c*) the form *resniceki* from the South of France, and (*d*) a form from Berlin, for which he suggested the name *borussia*, as being distinct from all other forms, first in the ♂ by its greater size; secondly in the extreme width of the black border of the fore-wings. This extends sometimes to such an extent that almost one-third of the wing is covered. On the under side both ♂ ♂s and ♀ ♀s are somewhat darker brown than usual. Otherwise the ♀ does not differ from the typical form. The same form is reported by Herr Zobel from Osterode, East Prussia, but the series from Friederichroda (Thüringer Wald) indicated that it did not extend as far south as that locality (described in current year of the Berl. Ent. Zeitschrift).

Mr. Dadd then proceeded to exhibit a pair of *Scodiona belgiaria*, var. *favillacearia*, and a typical ♂ for comparison, this being the only form of the species occurring on the heather around Berlin; and four examples of butterflies which he suggested as hybrids, viz., *Lycæna corydon* × *bellargus*, from Airolo, captured June 1907, *bellargus* being at the time a common species at the locality. *Cœnonympha satyrion* × *pamphilus*, from Wengen in June 1904, both *satyrion*

and *pamphilus* being common there; *Colias hyale* × *palæno* from Oberstdorf July 1905, *hyale* being frequently seen in the neighbourhood, but the presence of *palæno* not established: a doubtful hybrid, but pronounced as such by several Berlin authorities; *Pieris napi* × *rapæ* from Berlin, apparently exactly intermediate between the two species.

Specific identity of two forms of Charaxes from South Africa.—Professor E. B. Poulton, F.R.S., exhibited a series of seven *Charaxes neanthes* and one *C. zoolina*, all reared by Mr. G. F. Leigh, F.E.S., from the eggs laid by a single female *neanthes*. He said that, although the evidence as it stood was not entirely convincing, the independent experience of other naturalists rendered it in the highest degree probable that the conclusions suggested by the presence of the single *zoolina* in the family of *neanthes* were sound and permanent. Mr. Leigh's account of his interesting discovery was as follows:—

Charaxes neanthes, Hew. (1854), a form of *C. zoolina*, Westwood (1850).

Having in January 1905 bred from the same larvæ, or what I took to be the same larvæ, both *Charaxes zoolina* and *C. neanthes*, although so different, I determined if possible to obtain ova and try to rear them. On 18th May, 1908, I followed up a ♀ *C. neanthes*, and obtained 18 ova, and should have obtained more, but the insect was then captured by a bird. All hatched on the 23rd and 24th May, and I put the larvæ on their food-plant, an Acacia, *Entada natalensis*, but was very unfortunate with them, no less than 9 dying during the 1st and 2nd stages. The leaves fold up at night, but open again in the wild state, but when picked and put in water they do not open: this I believe was the cause of the mortality; for I was obliged to keep taking the larvæ off the old food and putting them on to new. The 9 remaining larvæ throve and 8 became pupæ. One larva I preserved, and have sent with the insects, as also the empty pupa-cases. The *C. zoolina*, a female, was the 3rd to emerge, and I give full particulars of the emergence from pupæ. In January next I will breed again from *C. zoolina* ♀, as this form is then more plentiful than in

August, and I also hope to obtain a larger number of ova. All the 8 specimens now sent are midgets, owing to the larvæ being starved in July, because, in consequence of ill-health, I was unable to get them fresh food often enough. The times of pupation and of emergence were as follows:—

1.	*C. neanthes* ♂		Pupated	4/8/08	Emerged	17/8/08.
2.	„	♂	„	6/8/08	„	18/8/08.
3.	*C. zoolina*	♀	„	5/8/08	„	18/8/08.
4.	*C. neanthes*	♂ Cripple	„	6/8/08	„	19/8/08.
5.	„	♂	„	7/8/08	„	20/8/08.
6.	„	♀	„	8/8/08	„	23/8/08.
7.	„	♂	„	10/8/08	„	26/8/08.
8.	„	♂	„	11/8/08	„	28/8/08.

I may mention that Mr. E. L. Clark, F.E.S., of Congella, bred 2 *zoolina* and 4 *neanthes* in January this year from what he took to be the same larvæ.

G. F. Leigh, F.E.S.,
Durban, Natal.

Professor Poulton said that he had submitted Mr. Leigh's paper to Mr. G. A. K. Marshall, who had replied as follows:—

London, Oct. 8, 1908.

"Leigh's results with *Charaxes neanthes* are extremely interesting, but I am not at all surprised to hear of them. I have always been struck by the very close relationship of this form to *zoolina*, and at one time thought they might be seasonal forms one of the other; but such dates as I could obtain did not seem to quite agree with that idea."

Professor Poulton observed that the far more cryptic under surface of *neanthes*, together with its general colouring, suggested a dry-season form. He had asked Mr. Marshall for his experience of the duration and succession of the wet and dry seasons in Natal, and his friend had kindly supplied the following account:—

The early rains begin about mid-August and the wet season proper in mid-September, continuing until mid-March.

Then follows a month of showers until mid-April, when the dry season proper begins. In Durban showers are liable to occur occasionally in the dry season.

Mr. Roland Trimen, F.R.S., gives in his "South African Butterflies," December, January, April to August, and especially May, as the times of appearance of *neanthes* in Kaffraria Proper, and for *zoolina* in the same locality, autumn, and not after the beginning of April.

The following dates of capture of these two forms in various localities have been copied from the labels accompanying the specimens in the Hope Department.

NATAL.

Captured by G. A. K. Marshall at and near Durban, Natal.

Durban	April 4, 1896	*zoolina*	♂.
Malvern, 800 ft.	March 10, 1897	*neanthes*	♂.
,, ,,	March 27, ,,	,,	♂.
,, ,,	April 1, ,,	,,	♂.
Durban	May 2, ,,	,,	♂.
,,	May 2, ,,	,,	♂.
,,	May 9, ,,	,,	♀.

S.E. RHODESIA.

Captured at Chirinda Forest, Melsetter, Gazaland (3800 ft.), by G. A. K. Marshall and C. F. M. Swynnerton.

Sept. 27, 1905, *neanthes* ♀ (G. A. K. M.)
March 1–6, 1907, *zoolina* ♀ (C. F. M. S.)
March 12, ,, ,, ♀ (,,)
April 10, ,, ,, ♀ (,,)

N.E. RHODESIA.

Captured by S. A. Neave at Petauke, East Loangwa district, N.E. Rhodesia: 2400 feet.

March 13, 1905	1	*neanthes* ♂
	1	*zoolina* ♂
March 30, 1905	1	,, ♀

BRITISH EAST AFRICA.

a. *Coast District.*

Captured by Rev. K. St. Aubyn Rogers at Mangea, about 75 miles N. of Mombasa: about 500 feet.

July 18, 1906 . . . . . 1 *neanthes* ♂

b. *Taita.*

Captured by Rev. K. St. Aubyn Rogers at Dabida Mountain, Taita, British East Africa: about 4800 feet.

May 25, 1904 . . . . . 2 *zoolina* ♂
May 28, 1904 . . . . . 1 „ ♀
May 31, 1904 . . . . . 1 *neanthes* ♂
June 11, 1904 . . . . . 1 *zoolina* ♂

c. *Taveta.*

Captured by Rev. K. St. Aubyn Rogers, etc., at Taveta, British East Africa: about 2500 feet.

April 19, 1905 1 *zoolina* ♂
May 1, 1905 1 „ ♂
May 4, 1905 1 „ ♂
May 6, 1905 1 „ ♂
May 8, 1905 1 „ ♂
May 10, 1905 1 „ ♂
May 12, 1905 4 „ 3 ♂ 1 ♀
May 17, 1905 3 „ 1 ♂ 2 ♀
May 22, 1905 1 „ ♂; 1 *neanthes* ♂
May 1–31, 1905 8 *zoolina* 4 ♂ 4 ♀; 3 *neanthes* 2 ♂ 1 ♀ — Presented by C. A. Wiggins. Collected by native.
July 1, 1905 1 „ ♂
Jan. 19, 1906 1 *zoolina* ♀

d. *Nairobi.*

Collected by A. H. Harrison: 5500 feet.

March 10, 1903 . . . 1 *neanthes* ♂
May 17, 1903 . . . . 7 „ 6 ♂ 1 ♀

e. *N.E. shore of Victoria Nyanza.*

Collected by C. A. Wiggins and A. Vincent near Kisumu: 3770 feet.

Dec. 1, 1902 . . .	1	*zoolina*	♂ (C. A. W.)
	1	*neanthes*	♂ (C. A. W.)
Dec. 8, 1902 . . .	1	„	♂ (C. A. W.)
March 25, 1903 . .	1	„	♀ (C. A. W.)
March 27, 1903 . .	3	„	♂ (C. A. W.)
Aug. 1–15, 1903 .	3	„	♂ (C. A. W.)
Oct. 15, 1903 . .	1	„	♂ (A. V.)
Nov. 1903 . . .	2	„	♂ (A. V.)
	1	*zoolina*	♂ (A. V.)

Collected by C. A. Wiggins, at Kalachonyo, 20 miles S. of Kisumu: 3800 feet.

Dec. 19–27, 1902 . . . . . 1 *neanthes* ♂

Collected by A. H. Harrison, at Kamagombo, S. Kavirondo.

Jan. 24, 1903 . . . . . 1 *neanthes* ♀

In addition to the above there are 16 *zoolina* (4 ♂ 12 ♀) and 2 *neanthes* (1 ♂ 1 ♀) collected in British East Africa by Mr. A. H. Harrison. These are without further data of time and place.

The above series of specimens shows a reversal in the proportions of the two forms in the northern part of the range. Thus in British East Africa the more conspicuous *zoolina* appears generally to preponderate over the more cryptic *neanthes*, while in Natal the converse relationship holds. We are reminded of *Precis archesia* in which also the more conspicuous form *pelasgis* is abundant in the north, while the far more cryptic form, *archesia*, is apparently rare.

If the two forms of *Charaxes zoolina* are seasonal it is evident that they are by no means confined to their respective periods of the year.

Dr. Karl Jordan stated that he was not at all surprised at Mr. Leigh's results; for there were no structural differences between *zoolina* and *neanthes*. He also said that other forms in the same genus would doubtless require to be united in

the same manner. The following account was subsequently prepared by Dr. JORDAN :—

The experience gained by Mr. Leigh throws new light on quite a number of forms of *Charaxes*. There are two *Charaxes* of this group in Madagascar, *betsimisaraka* representing the African *zoolina*, and *betanimena* representing *neanthes*. These two Malagasic forms both differ in the same way from the corresponding African *Charaxes*, which is additional evidence for the correctness of the result of Mr. Leigh's experiment in breeding. Further evidence is afforded by four West African *Charaxes*, two of which have the facies of *zoolina*, while the two others correspond in colour to *neanthes*. These four *Charaxes* belong doubtless to but two species instead of four, each species being dichromatic. One pair of forms is apparently the West African sub-species of *Charaxes zoolina*, while the other pair are a species distinct from *Ch. zoolina*. As the *zoolina*-form of the West African sub-species has no name I propose to call it

form *phanera*.

It differs from the greenish and black *zoolina* of South and East Africa mainly in the costal margin of the fore-wing being less extended black, in the hind-wing bearing a distinct pointed tail at the lower radial (as in *ehmkei* !), and in the under side of the same wing having distinct whitish admarginal spots between the costa and second radial.

Type of name : Canhoca, Angola (5, xii. 03, Dr. Ansorge).

The following table shows the relationship of the various forms in question according to the result of Mr. Leigh's experiment. I add that we cannot find any structural differences between the forms here united under *Charaxes zoolina*, and that apparently there is also no constant structural character by which *Ch. ehmkei* could with certainty be distinguished from *Ch. zoolina*.

1. *Charaxes zoolina*, Westw. (1850).
   a. *Ch. z. ehmkei*, Dew. (1882).
      a^1. form *ehmkei*, Dew., tawny and white; known form Northern Angola.
      a^2. form *phanera*, nov., greenish and black; known

from Northern Angola, found by Dr. Ansorge at the same time (late in November and early in December) and the same place (Canhoca) as the preceding.

b. *Ch. z. zoolina*, Westw. (1850). Both forms found from Natal northward to Uganda and Abyssinia.

b[1]. form *neanthes*, Hew. (1854), tawny.

b[2]. form *zoolina*, Westw. (1850), greenish and black.

c. *Ch. z. betsimisaraka*, Lucas (1872). Both forms from Madagascar.

c[1]. form *betanimena*, Lucas (1872), tawny.

c[2]. form *betsimisaraka*, Lucas (1872), greenish and black.

2. *Charaxes kahldeni*, Homeyer (1882).

a[1]. form *homeyeri*, Dew. (1882), tawny and white; known from Pungo Andongo, Angola.

a[2]. form *kahldeni*, Homeyer (1882), greenish and black; known from Northern Angola, the Upper Congo, and Southern Cameroons.

Herr A. von Homeyer obtained *kahldeni*, *homeyeri* and *ehmkei* at Pungo Andongo in Northern Angola. Very few specimens of *homeyeri* seem to be contained in collections (we have only a pair from the Homeyer collection), while *kahldeni* has more frequently been obtained in several districts.

Professor Poulton remarked that it was extremely interesting and inspiring to see so much new light thrown on this important genus as the result of Mr. G. F. Leigh's experiment.

Paper.

Dr. F. A. Dixey, M.A., M.D., read a paper, illustrated by lantern slides, "On Müllerian Mimicry, and Diaposematism. A Reply to Mr. G. A. K. Marshall." A discussion followed on the whole subject, in which Mr. R. Shelford spoke in favour of Mr. Marshall's views, and Professor E. B. Poulton, F.R.S., in favour of Dr. Dixey's contentions. Later Mr. G. A. K. Marshall communicated the following reply to Dr. Dixey: —"Having unfortunately been prevented by illness from attending the reading of Dr. Dixey's long-expected paper in

reply to my criticisms of his hypothesis of Diaposematism, it is obviously impossible for me to make any adequate rejoinder at present. But there is one point to which I should like to reply immediately. When my paper was read in March last, Dr. Dixey in the course of the few remarks that he made afterwards stated that I had 'given myself away rather badly' on one or two points, though the nature of my supposed blunders was in no way indicated. I now learn that the principal point upon which I am supposed to have 'given myself away' is that I have assumed that it is an essential feature of the hypothesis of Reciprocal Mimicry that the two inedible forms should mimic each other *simultaneously*. Now, I understand that this suggestion is repudiated by Dr. Dixey, who further claims that the hypothetical kind of mimicry which I have called Alternating Mimicry (Tr. Ent. Soc. 1908, p. 103) is merely part and parcel of his own hypothesis of Diaposematism. I may here explain that the idea of Alternating Mimicry is based on the supposition that where two inedible species of practically similar distastefulness are mimetically associated then the mimetic approach will be in one direction only, and will be determined by the relative numbers of the two forms. If A be numerous and B much less so, then B will mimic A; and if subsequently through other causes the relative numbers of the two forms became reversed, then B would cease to mimic A, and provided always that the necessary variations arose, A would begin to mimic B. The resulting interchange of characters is what I should call Alternating Mimicry.* Let us now examine what Dr. Dixey has actually said with regard to the nature of the mimetic approach in the case of his Reciprocal Mimicry. In Tr. Ent. Soc. 1894, p. 297, he defines Reciprocal Mimicry as being produced by 'A and B converging to a point between them,' and further on the same page describes the process as '*mutual convergence*' (the italics are his). On p. 298, foot-note, he points out specially that he does not use 'convergence' in Professor Poulton's sense, namely, as signifying the assimilation of one form to another,

* Strictly speaking, Diaposematism is a term more applicable to this form of Mimicry than to Reciprocal Mimicry.

but as meaning 'the mutual approach by two forms to a mean between them.' In Tr. Ent. Soc. 1896, p. 74, he refers to his conception as 'a kind of give-and-take arrangement, in consequence of which two or more inedible forms may hasten the assimilative process by imitating each other;' and of course such hastening can only take place when the approach is simultaneous. In Tr. Ent. Soc. 1897, p. 324, we are informed that 'the benefit of Müllerian Association being mutual, there is a distinct reason . . . for the model to help on the process of assimilation by *itself advancing to meet* the mimic' (the italics are mine). But in order that there may be no possibility of a misapprehension Dr. Dixey in the same paper (p. 328) gives a very precise definition as to what we are to understand when he uses his term Reciprocal Mimicry. This expression, he says, 'is meant to convey, besides the general idea of convergence, the special information that in the cases to which the term is applied, the convergence is brought about *not by the simple imitation of one form by another*, but by the interchange of features between forms and their consequent *simultaneous approach* to an intermediate position' (the italics are mine). Now unless we are to interpret words in a distorted sense, it seems to me that the above passages must assuredly convey the definite idea that Reciprocal Mimicry involves the conception of a mutual *simultaneous* approach on the part of two species. Indeed, from the last-quoted definition, we may legitimately infer, that whatever he may think now, Dr. Dixey *then* considered that simultaneous approach was the natural consequence of that give-and-take interchange which his hypothesis postulates; and the whole internal evidence in his papers is in accord with that view.

"Then as to the claim that Alternating Mimicry is practically the same thing as Reciprocal Mimicry. This is a statement which I am entirely unable to accept. Throughout Dr. Dixey's writings I can find no trace whatever of the conception of Alternating Minicry as I have defined it above. It has been seen that this conception is based entirely on the view that the relative number of individuals is the most important factor in determining the direction of the mimetic approach between any two species of equal inedibility. Yet

this question of relative numbers has been entirely neglected by Dr. Dixey in dealing with his supposed cases of mimetic interchange. How can he explain this strange omission if Alternating Mimicry was really an essential portion of his hypothesis as he suggests? It is difficult also to understand how he could have made the following assertion: 'It seems hitherto to have been taken for granted that a dominant form will attract or retain other species within its own sphere of influence, without being itself attracted in return; whereas the fact is, as we have seen, that each member of an inedible association has more or less influence upon all the rest' (*op. cit.* 1897, p. 327). Now I do not at all accept the validity of this theoretical 'fact,' and it is quite at variance with the principle which underlies the suggestion of Alternating Mimicry. One final quotation will suffice. We have been told that 'the most complete intermingling of characters given and taken on both sides may be expected when two species meet on equal terms, neither being strong enough to predominate over the other' (*l. c.*). This then is considered to be the *optimum* condition for the production of Reciprocal Mimicry, and it is obvious that any possibility of Alternating Mimicry is entirely excluded; indeed, from the standpoint of that hypothesis there would be no mimicry at all in such a case, because the species would be in what I have called a state of mimetic equilibrium. It is also obvious that if mimetic approach be possible between two such species, then it must necessarily be simultaneous. I therefore feel entitled to claim that I was fully justified in asserting simultaneous approach to be an essential feature of the hypothesis of Reciprocal Mimicry, and that I was also justified in treating Alternating Mimicry as a conception differing radically from it."

Wednesday, November 4th, 1908.

Mr. C. O. Waterhouse, President, in the Chair.

Election of Fellows.

Mr. Norman P. Fenwick, junior, of the Gables, Esher; Mr. John Spedan Lewis, of Spedan Tower, Hampstead, and 278–288, Oxford Street, W.; Mr. W. K. Lister, of Street End House, Ash, near Dover; Mr. Ivan E. Middleton, of 14, High Street, Serampore, Bengal; Mr. F. E. West, of Peradeniya, Ceylon; and Mr. J. Swierstray, 1st Assistant of the Transvaal Museum, Pretoria, were elected Fellows of the Society.

Exhibitions.

Forms of Melitæa aurinia.—Mr. W. G. Sheldon exhibited examples of *Melitæa aurinia*, var. *iberica*, from Barcelona, taken last May, and forms from various British and Continental localities for comparison. The Spanish specimens showed remarkable intensity of wing coloration and marking, and in this connection it was noticeable that the larvæ from which they were bred were found feeding on a species of *Lonicera*, and not on the usual plantain which was also abundant. Taking into consideration their different appearance and habits, Mr. Sheldon suggested that eventually this particular form of *aurinia* might prove to be a distinct species, or at all events a sub-species.

Rare Tachinidæ.—Mr. H. W. Andrews showed a short series of *Gymnosoma rotundatum*, L., and a specimen of *Ocyptera brassicaria*, F.—two uncommon species of *Tachinidæ*—from Glengarriff, co. Cork.

Erebias from the Vosges.—Mr. P. J. Barraud exhibited a series of *Erebia stygne* from the Vosges taken in June and July this year, at 4000 ft., showing a generally brighter facies and markings than Swiss forms, and a large brightly coloured series of *Erebia ligea* from the same region at 2–2400 ft., in July.

Nonagria new to Britain.—Mr. H. M. Edelsten exhibited on behalf of Mr. E. P. Sharp, and Mr. A. J. Wightman who was present as a visitor, a series of *Nonagria edelsteni*, Tutt (= *neurica*, Schmidt), from Sussex, taken in August this year, this being the first time that the species, which is quite distinct from *N. neurica*, Hb. (= *dissoluta*, Tr. = *arundineta*, Schmidt), had been observed in this country. He also showed for comparison long series of *N. neurica* (*arundineta*) and var. *dissoluta*, from various British localities, with *N. neurica* from Germany.

Mr. J. W. Tutt stated that great credit was due to Messrs. Wightman and Sharp for their discovery of *Nonagria edelsteni* as a British insect. He pointed out that as far back as 1802 Hübner figured the well-known allied species, with the dark basal half of the reniform surrounded by a pale ring, under the name of *neurica*, whilst later, in 1818, he figured the dark aberration also as *neurica*, recognising them as the same species. Treitschke, in 1825, also maintained their specific unity, but called the dark form *dissoluta*. In 1858 Schmidt discovered two allied species: (1) with dark basal half to reniform with pale circumscription, evidently *neurica*, Hb., (2) a somewhat similar insect with white collar, three white spots edged with blackish placed longitudinally along the middle of the wing, the outer one corresponding with the dark spot of *neurica*, Hb. The first of these he unfortunately renamed *arundineta*, whilst the second he equally unfortunately referred to *neurica*, Hb. Herrich-Schäffer maintained Hübner's and Treitschke's conclusions; Staudinger, in his Catalogue, unfortunately followed Schmidt, and, in turn, was followed by the collectors who used the Catalogue. In pointing out this series of errors recently Mr. Tutt had found it necessary to rename the species that Schmidt had erroneously referred to *neurica*, Hb., and in doing so called it *edelsteni* (Ent. Rec., xx, pp. 164 *et seq.*), in honour of Mr. H. M. Edelsten, who had done so much towards making known to us the differences of Schmidt's two species.

Pseudogynes of Formica rufa.—Mr. H. St. J. Donisthorpe brought for exhibition Pseudogynes captured alive at Nethy Bridge in September last, where they occurred in some

numbers in two nests of *Formica rufa*, thus indicating that *Atemeles pubicollis*, Bris., a beetle not as yet taken in Britain, is to be found in Scotland.

Rare British Coleoptera.—Mr. Donisthorpe also exhibited (*a*) twenty-two specimens of *Harpalus cupreus*, Dej., not taken in any numbers for twenty years, from Sandown, I.W., October 1908; and one specimen with red legs discovered by Mr. J. Taylor at Atherstone, I.W., in August 1900; (*b*) *Cafius cicatricosus*, Er., found at Southsea in the same month; and (*c*) *Cryptocephalus bipunctatus*, L., over twenty examples, taken in July by the exhibitor at Niton, I.W., in July; this form being new to Britain until taken by Mr. R. S. Mitford at Niton last year.

Stick Insect.—Mr. R. Shelford showed a "Stick" insect —apparently a new species of the genus *Menexenus*—bred parthenogenetically by Mr. H. Main.

Hybrids of Ocellatus and Populi.—Mr. L. W. Newman exhibited a case containing a long series of *smerinthus* hybr. *hybridus*. Almost all the ♂s appeared to be true ♂s, but there were traces of gynandromorphism in the intermediate characters of the antennæ in two; and though the ♀s superficially presented ♀ characters, it had been discovered that three at least showed traces of the ♂ genitalia combined with those of the ♀.

Life Histories of Coleophorids, and hybernating Porthesia.—Mr. H. J. Turner exhibited the life history of *Coleophora virgaureæ*, including (1) A long series of imagines bred from larvæ obtained at Woolwich on the flowers and seeds of Golden-rod (*Solidago virgaurea*); (2) Flowers of Golden-rod among the pappus hairs of which were ova (infertile); (3) Photomicrographs by Mr. F. Noad Clark of the ova *in situ*, showing an ovum just before the emergence of the larva, the larva in the act of emergence through the micropylar cells, and the ovum shell just after the emergence; (4) Photomicrographs of three varieties of the micropyle of the ovum, one having five cells, another six and a third seven; and (5) Larval cases *in situ* among the florets, some thin, white, flimsy, newly made cases, some of different shades of brown, stouter, older cases, others dark, blackish,

wintering cases suited to the colour of the dead seed-heads and stems of the Golden-rod, all covered by the pappus hairs attached around the "neck" of the cases. The ova were pointed out as being "upright," and although they were not attached by their base yet they were thrust base downwards among the pappus hairs to which they adhered by their sides. The micropyle was upward.

Mr. Turner also showed "nests" of the gregarious hybernating larvæ of *Porthesia chrysorrhœa* from Wakering marshes, Essex, and stated that on several parts of the coast this species had now become very abundant again, plenty of nests being everywhere apparent. One of last year's nests was exhibited to show that not only were the larvæ gregarious during their feeding period, but that they spun up for pupation in company. These nests were to be found on blackthorn and hawthorn, and occasionally on wild rose.

From the same marshes Mr. Turner exhibited the dead flower-stems of *Statice limonium* collected on Nov. 1st, containing the full-fed hybernating larvæ of *Coleophora limoniella*. The position of each larva was indicated by the abandoned case of the feeding period attached at the "door" of the gallery. Later in the year these cases, which are loosely attached, fall off, and the only indication remaining is a very delicate silken diaphragm which the imago ruptures at emergence. Two, three, and four larvæ were often found in one stem and at from one to five or six inches from the ground surface. Imagines and larval cases *in situ* among the flowers were also exhibited.

Rare Earwig and cells of Wasp.—Mr. W. J. Lucas exhibited an example of *Labidura riparia*, Pall. (Shore Earwig), a large male taken near Bournemouth, Aug. 10, 1908, and kept alive since that date. It was fed chiefly on fish, but about Sept. 27 it ate a smaller companion that had been living with it for some time. This species dates as British from 1808; but till a few years ago only some half-dozen captures were known. Then in 1900 Major Robertson found one ♀ near a lamp in Pokesdown. Next his daughters found out their mode of concealment during the day on the shore, and from that time there has been no difficulty in securing speci-

mens. It occurs on the shore in Hants and Dorset (? Kent); and has been taken casually in Liverpool.

He also showed two cells of the solitary wasp *Eumenes coarctata* found in New Forest on Oct. 31, 1908, having never found two together previously.

The Double or Combined Aposeme.—Dr. F. A. Dixey exhibited specimens of *Heliconius amphitrite*, Riff., and *H. charithonia*, Linn.; also a coloured drawing of *H. hermathena*, Hew. He remarked that each of the first two species showed a distinct and well-marked aposeme or warning character; each of them, and especially the first, belonging to an extensive mimetic assemblage. In the third species these two distinct aposemes were combined.

These specimens illustrated the fact that a conspicuous and distasteful form might acquire a new aposeme without relinquishing its old one, such an intermediate form presumably sharing in the protection afforded by the aposematic forms on each side of it, while the separate aposemes which it exhibited were not mutually protective. This would give the intermediate form an advantage over the extremes, provided that all were found in the same district, or (which was not quite the same thing) were exposed to the attacks of the same enemies. In this particular case the facts of geographical distribution made such a protective relation between the forms unlikely; but the series afforded a good illustration of the actual existence of what he had before spoken of as the "double" or "combined" aposeme.

Forms of Polyommatus bellargus, and Zygæna.—Dr. G. G. Hodgson, who was present as a visitor, exhibited a series of *Polyommatus bellargus* from Surrey localities, including a partially gynandromorphus ♀, two-thirds of the hind-wings with the typical ♂ coloration and markings: a series of var. *ceronus* taken in 1907, and specimens showing a variant underside recurrent in the same locality. He also exhibited a series of *Zygæna trifolii*, and *Z. hippocrepidis* from one locality, including twelve melanic examples of the former, with other common forms and aberrations, probably of the latter, with the sixth spot wanting, or represented by a mere dot.

Professor E. B. Poulton, F.R.S., exhibited the male and female imago, the preserved larva and the cocoon of an interesting new Lasiocampid moth discovered near Durban by Mr. E. L. Clark, F.E.S., who had sent the following note :—

"In December last year I found what I at once recognised as a rare caterpillar, while engaged on some work at Bellair, a suburb of this town. There was a considerable quantity of them, and I took over a score altogether. I distributed some of the larvæ to other collectors, and at the same time preserved several. From the remainder I bred in the course of last March, 8 ♀ and 1 ♂. The male was in very poor condition, as it started to flutter its wings and wore the edges into shreds before I knew that it had emerged. In fact, it was the drumming of its wings that called my attention to it, the noise being like a continual hum. No one here recognised the moth, nor did Sir George F. Hampson to whom I sent larvæ, pupæ and imago. I then sent a specimen of each to Prof. Chris. Aurivillius, who kindly described it as *Glocia clarki*. I am happy to say that my few remaining pupæ are now emerging. Last week I bred 1 ♂ and 1 ♀. This time by good luck I saw the ♂ before he started to exercise his wings, and he is perfect. The fact that two broods have emerged from a single batch of cocoons is interesting. The larvæ taken last December were evidently the outcome of the late 1907 brood, as most of the *Lasiocampidæ* known to me are very slow feeders. The tree they feed on (*Dichrostachys nutans*, Bth.) seems very scarce round Durban, and I do not yet know of one nearer than Bellair."

Professor Poulton then read the following letter from Mr. S. A. Neave, F.E.S., describing the habits of a mimetic species of *Euphædra* :—

Nr. Kasama, N.E. Rhodesia, May 13, 1908.

"I am now back again on the High Plateau, and find the Fauna very interesting, on the whole similar to that of the higher ground in Katanga. *Mimacræa marshalli* and *Pseudacræa poggei* both occur, but are rare. Perhaps I am a bit late. One thing here which affects the fauna is the scarcity of virgin forest. The natives here have been accustomed for generations to destroy huge areas for cultivating their gardens.

This is all stopped now by the Administration, but it will take the country a long time to recover.

"I have not taken very much of Bionomic interest lately, except 5 or 6 specimens of a sp. of *Euphædra*, probably *E. eusemoides*, Grose-Smith and Kirby—the one with a yellowish bar across the fore-wing and a magenta black-bordered hind-wing, which mimics a gaily coloured diurnal Agaristid moth of the genus *Eusemia*. I did not take the moth, which is common everywhere at the beginning and during the middle of the rains, because I think I was too late for it. I have noticed before that individuals of the genus *Euphædra* seem to be very long-lived and live on until their wings are mere shreds. When I was on the Lufupa River last October at the end of the dry season there were a number of much-worn individuals haunting the shady dry river beds, evidently survivors from the previous wet season. The interesting thing about the above species of *Euphædra* is that it differs in its *habits* from its allies. It spends little or none of its time on the ground as they nearly all do, but is constantly flying around trees and large shrubs,—*the very thing its model is fond of doing*. One or two of my specimens were caught by sending small boys up trees after them.

"I have taken at least two species of *Hesperidæ* with well-marked Acræine under surface."

Professor E. B. Poulton also exhibited a set of 23 butterflies captured on a patch of Zinnia in the course of half-an-hour, Feb. 21, 1906, at Jinja (3775 ft.), on the N. of the Victoria Nyanza, by Mr. C. A. Wiggins, F.E.S. Seventeen specimens were *Danaida chrysippus*, L., of the type and *alcippus* forms, together with intermediate examples. Not a single specimen of *dorippus* (*klugii*) was present, although of three females of *Hypolimnas misippus*, L., two were of the *inaria*, Cr., form, mimicking *dorippus*. Similarly of two *Acræa encedon*, L., one was the form *daira*, Godm. and Salv., resembling the same model. The twenty-third specimen was a female of *Acræa terpsichore rougeti*, Guér., a very poor and perhaps incipient mimic of the type form of *chrysippus*. Professor Poulton pointed out that at Gondokoro to the N., Entebbe to

the S.W., and everywhere eastward from the N.E. shores of the Lake to the coast, the *dorippus* form was more abundant than the type form, and that in all his experience he had never received from any of these localities such a group as that now exhibited.

A Mimetic Group of Indian Celastrinids (Cyaniris) and Everids.—Dr. T. A. Chapman exhibited specimens of several species of Indian Lycænids, forming a group curiously alike, especially on the upper surface; so much so that, with regard to the first four of them, none of our great authorities on Indian Butterflies express any clear view of them. He said:—

"Moore named *C. sikkima*, but afterwards mixed specimens of it with his series of *jynteana*, while de Niceville and Bingham sunk it, as possibly a seasonal variety of *jynteana*, but actually indistinguishable from that species. *C. sikkima* is, however, a form of *C. argiolus*, and very distinct from *C. jynteana*.* *B. chennellii* was regarded by de Niceville as a *Celastrina* (*Cyaniris*), it is however not a Celastrinid, but an Everid. I feel sure that de Niceville would not have made such a mistake on the simple merits of *B. chennellii*, and therefore believe that though his type specimen of *B. chennellii* belongs to the species known under that name, he really formed his first (and correct) opinion from *N. binghami*, afterwards making his description from a *B. chennellii*.

"Col. Bingham's specimen (or at least the one he showed me as certainly correctly named) of *B. chennellii* proved to be a specimen of *N. binghami*. I presume that if de Niceville's series of *chennellii* is examined, it will be found to include examples of *binghami*. Since noting the latter species in Proc. Zool. Soc., 1908, p. 676, I have found a third specimen in Moore's series of *C. jynteana*, so that this series contained specimens of *jynteana*, *sikkima* and *binghami*. This specimen is the one here exhibited. I have to apologise for the condition of this and other examples shown, as I have only brought specimens belonging to myself, but I have worked out the questions involved in larger numbers of better specimens in the British Museum, and elsewhere. I exhibit also a specimen

* See Tutt's "Brit. Lep.," vol. ix, p. 403; also pl. xxviii, p. 388, for figures of appendage of *Celastrina argiolus*, and *C. argiolus*, var. *sikkima*.

of a fifth species, that is I think probably undescribed and probably from India.* Mr. Druce possesses a better specimen of the same species from Java. It closely resembles the previous four. Some forms of *Zizera maha* approach the group very nearly.

"I may take this opportunity to correct some ambiguities in my notes on *Bothria chennellii* and *Notarthrinus binghami* already referred to. I mention there that *B. chennellii* is *Zizera*-like and not a *Cyaniris*.

"Moore's genus *Zizera* by description refers to an Eastern group of Celastrinids, of which we may take *maha* as type. But he specified *Cupido alsus* (*minimus*) as type. *Alsus* does not, however, agree with his definitions of the genus, and is in fact an Everid. *Bothria chennellii* agree with *C. alsus*, and is also an Everid.

"The Everids have the costal and sub-costal veins actually coinciding for some distance. *Zizera* (with *maha* as type, and by Moore's definition) has them nearly parallel and touching (first sub-costal 'slightly touching the costal nervure near its end.' Moore).

"I had not worked this out when I wrote my notes on *B. chennellii*. This resulted in my uncertain note as to whether *Zizera* was Cyanirid or Everid. My picture of *Zizera* was of the neuration of *C. minimus* and the appendages of the true Indian forms, actually a non-existent absurdity.

"I have added to the group two species of *Everes*. They are of smaller size and possess tails, but these circumstances do not obscure their close resemblance to the main species. These two specimens are from Moore's series of *E. dipora*, one is a form of *Everes argiades*, the other is *E. dipora*. This may be called var. *diporides*, Moore's type specimen is *dipora* and not *diporides*. This mixture of species may to some extent explain why de Niceville, Elwes and others regarded *E. dipora* as merely a form of *E. argiades*. I believe Mr. Bethune-

* This species is possibly entitled to a new genus, but it may for the present be placed in *Zizera* (*maha*, not *alsus*, as type). I cannot identify it with any species of that genus and so venture to call it *dryina* (δρυς = Druce). It is 30 mm. in expanse, of a rather purple blue (like *chennellii* or *sikkima*) with a very broad, dark border. I would, however, especially define it as possessing the ancillary appendages figured (Pl. B).

Baker proposes to deal with the question of *E. dipora*, so will not enlarge on this very interesting species. But there is one point to which I wish to call special attention, and that is that *C. sikkima* is a race of *C. argiolus*, *C. jynteana* a race of *C. limbatus*, and the *Everes diporides* is a race of *E. argiades*. These three are blues with very little if any black margins to the wings. It is very possible that further research may show that the other species have forms without dark borders; so far I have not met with such forms. All these species, *C. sikkima*, *C. jynteana*, *B. chennellii*, *N. binghami*, *E. dipora*, and *E. diporides*, occur, presumably more or less together, in the Khasya district, and probably in other areas, though I have not records of *all* the species from any other one district.

"I differentiate the species, doubtfully by their wing characters, but I might almost say infallibly by the genitalia, which happen in these forms to be in every case remarkably different from those of any other of the group.

"As to which is the model and what may be the object of this mimetic group, I will hardly venture to say anything. But it is clear that the blue *argiolus* joins the group as *sikkima*, the blue *limbatus* (which seems to be identical with *placida* specifically) as *jynteana*, and the blue *argiades* as *diporides*. *E. dipora* is closely allied to *argiades* and was therefore originally blue. This would leave *chennellii* or *binghami* as probable models.

"*C. argiolus*, whatever it may be elsewhere, is in India clearly a species looking for protection in many directions. It is curious that though something like a dozen forms of *argiolus*, differing in no great degree from the ordinary form, have received specific names as distinct species, only two forms of very different facies have been recognised by being named as distinct species, viz. *sikkima*, already dealt with, and the still more remarkable form *victoria*, Sw. In addition to these are two forms of which I exhibit specimens, one of which resembles *puspa* and the other *albocæruleus* (or *marginata*). This latter form was found at South Kensington placed with *albocæruleus*.

"*C. victoria*, Sw., is a form of which I know little, and have

no idea of what the attraction was to give it an appearance so remarkably different from that of the type.

"The plates show the appendages of *Z. dryinus* (n. sp.) and of *Celastrina jynteana* (*limbatus*), of *Everes dipora* and *argiades*, var. *diporides*, and figures of the several species photographed in black and white.

" Figures of the appendages of the other species will be found in Proc. Zool. Soc. *l. c.* and Tutt's 'British Lepidoptera,' *l. c.* from my specimens."

Moth destruction in Saxony.—Col. J. Yerbury drew the attention of Fellows to the following extract from the " Times " of current date, relating to the method of destruction applied successfully at Zittau, Saxony, to the imagines of what appeared to be *Thaumetopœa* (*Cnethocampa*, Stph.) *pityocampa*.

"Satisfactory results have been recently obtained at Zittau, Saxony, by an ingenious method of insect destruction. The caterpillars of a certain kind of moth have been working great damage during the last few years in the fir woods of Germany where many thousands of acres have become a prey to the voracious insects.

"In the method employed for destroying them powerful searchlights were erected, which throw their light on the parts most frequently visited by insects from the neighbouring forests. The insects were destroyed by a fan exhauster placed close to the searchlights. A piece of wire gauze of about 1 cm. mesh was stretched out in front of the discharging opening of the exhauster, against which the moths are thrown. The apparatus used in connection with the definite tests comprises two searchlights ; resistances for controlling the current ; and flame-arc lamps for further lighting the suction opening of the fan. Three walls of the collector box consist of iron wire gauze of 7·5 mm. mesh. After being filled until preventing the passage of an adequate air current, the collector is removed from the fan and emptied of its contents.

"A point of special importance was to ascertain suitable elevated points for installing the electrical apparatus whence the most infested forests could be lighted as well as possible. Those selected comprised the roof of the city electricity works, the tower of the city hall, the roof of a municipal school, and

that of a factory. Excellent results were obtained, for at a single point as much as 30, 40, and even 64 kg.—that is, up to 400,000 moths—were destroyed."

Paper.

Mr. J. C. KERSHAW communicated a paper on "The Life History of *Erianthus versicolor*, Brunner, an Orthopteron of the family Mastacidæ."

Wednesday, November 18th, 1908.

Mr. H. ROWLAND-BROWN, M.A., Vice-President, in the Chair.

Nomination of President, Officers, and Council for 1909–10.

The VICE-PRESIDENT announced that the Council had nominated Dr. F. A. DIXEY, M.A., M.D., Fellow of Wadham College, Oxford, as President; Mr. A. H. JONES as Treasurer; Mr. H. ROWLAND-BROWN, M.A., and Commander J. J. WALKER, M.A., R.N., F.L.S., as Secretaries; Mr. G. C. CHAMPION as Librarian; and Dr. T. A. CHAPMAN, M.D., F.Z.S., Mr. A. HARRISON, F.L.S., F.C.S., Mr. SELWYN IMAGE, M.A., Dr. K. JORDAN, PH.D., Dr. G. B. LONGSTAFF, M.D., Mr. H. MAIN, B.Sc., Mr. G. A. K. MARSHALL, Professor E. B. POULTON, D.Sc., M.A., F.R.S., Mr. R. SHELFORD, M.A., Mr. ROLAND E. TURNER, Mr. J. W. TUTT, and Mr. C. O. WATERHOUSE, to be other Members of the Council for the Session 1909–10.

Election of Fellows.

Dr. MILLAIS CULPIN, M.B. (Lond.), F.R.C.S., of the Palace Hotel, Shanghai; Mr. EUSTACE MALLABONE EUSTACE, of Challacombe Rectory, Parracombe, R.S.O., North Devon; Captain FREDERICK HALLAM HARDY, R.A.M.C., Medical Officer of the British Central African Protectorate; Mr. JENS MARIUS ALFRED KNÜDSEN, of Noerre Nebel, Denmark; Captain LEONARD PAUL IRBY, of Brook House, Eastry S.O., Kent; and Mr. B. C. S. WARREN, of The Avenue, Amersham, Bucks, were elected Fellows of the Society.

Appointment of Auditors.

Mr. R. Adkin, Dr. T. A. Chapman, Mr. H. St. J. Donisthorpe, Mr. W. J. Kaye, and Mr. R. Wylie Lloyd, were appointed Auditors for the current financial year.

Exhibitions.

Rare Weevil.—Mr. E. C. Bedwell exhibited an example of the rare weevil *Procas armillatus*, F., taken by sweeping at Edwinstowe, near Sherwood Forest, in June 1908; and specimens of *Phyllobius argentatus*, L., and *P. maculicornis*, Laich., with deciduous mandibles attached.

New and rare Coleoptera.—Mr. W. E. Sharp, on behalf of Mr. P. de la Garde, showed specimens of the following new and rare Coleoptera:—*Laccobius purpurascens*, Newbery, recently described as new to science; *Ceuthorrhynchus parvulus*; and *Phyllotreta diademata*, recent additions to the British list; *Arena octavii*, *Sibinia sodalis*, *Neuraphes longicollis*, *Cardiophorus equiseti*, rare and local species; and a species of *Choleva*, having the right-hand maxillary palpus in triplicate.

New British Anthrocera.—Mr. W. S. Sheldon exhibited a specimen of *Anthrocera achilleæ*, from near Oban, Argyllshire, one of those taken by Mr. Renton and recently recorded as British, and forms of the species found in the South of France; with *A. filipendulæ*, and *A. exulans* from Scotland for comparison.

Aberrant Swiss Butterflies.—Mr. R. M. Prideaux exhibited (*a*) a gynandromorphous specimen of *Lycæna zephyrus*, var. *lycidas*, from the Simplon, taken in July last, with normal male and female for comparison: (*b*) an example of *Chrysophanus alciphron*, var. *gordius* ab. ♀ *midas*, Lowe, from below Salvan in the Rhone Valley, with normal ♀♀s for comparison; and (*c*) a striking aberration of *Melitæa didyma* with the spots of the lower wings coalescent in thick splashes, captured below Berisal in July 1905.

Identity of Charaxes.—Dr. Karl Jordan exhibited examples of *Charaxes zoolina*, and its nearest allies, *C. betsimisaraka* and *betanimena* from Madagascar, *zoolina* and *neanthes*

from East Africa, *phanara* and *ekinkei* from West Africa, *kahldeni* and *homeyeri* from West Africa. This exhibit confirmed the result of Mr. G. F. Leigh's breeding experiment mentioned by Professor E. B. Poulton at the last meeting.

Melitæas of the Athalia group.—The Rev. G. Wheeler exhibited a pair of *Melitæa dictynna*, var. *dictynnoïdes*, Horm., received from Herr Hormuzaki the previous day, and exactly corresponding with his description in "Iris," xi, p. 2 (1898). These are therefore absolutely authentic. They are the converse of *M. britomartis*, having the upper side of *M. dictynna* but the under much nearer to *M. parthenie*. The form is usually described as a var. of *M. aurelia*, Nick., but this seems unlikely, as almost typical *aurelia*—a specimen of which was exhibited—are found at the same place, Mt. Cecina, near Czernowitz, Bukowina. It may probably be a good species. A pair of *M. athalia* from the same locality was also shown, somewhat small and light in ground colour, but rather heavily marked.

Experiments in crossing British Pieris napi with Swiss Pieris napi, var. bryoniæ.—Mr. A. Harrison and Mr. H. Main exhibited a number of examples to illustrate the result of breeding experiments with British *Pieris napi* and Swiss *P. napi*, var. *bryoniæ*. Ova were obtained from *bryoniæ* taken in July 1906, on the Kleine Scheidegg Pass, and from these a series of imagines was bred in the spring of 1907. All the females were the var. *bryoniæ*. Although of course the form known as *bryoniæ* is confined to the female, it will be convenient to refer to the males also as *bryoniæ*. Some of these males were paired with English *napi* from Cornwall, and 195 insects were bred as a result of these pairings, emerging as follows :—

	Males.	*Females.*
In summer of 1907 . . .	32	20
In spring of 1908 . . .	65	63
In summer of 1908 . . .	—	15
Total	97	98

Most of these insects were quite typical *napi*, only one

specimen which emerged in 1907, and the 15 which emerged in the summer of 1908, showing any approach towards the form *bryoniæ*, and these are much nearer to *napi* than to *bryoniæ*. Some of the insects which emerged in the summer of 1907 were paired *inter se*, the progeny of which all emerged in the spring of 1908, being all *napi*, 9 males and 19 females.

Some of the first generation which emerged in the spring of 1908 were also paired *inter se*, but so far only 5 specimens have been bred and they are all typical *napi*, 2 males and 3 females; some pupæ of this generation are lying over the winter, presumably to emerge in the spring.

An attempt to obtain the reciprocal pairing, viz. English *napi* male with *bryoniæ* female, was a failure in 1907; but in the spring of 1908 we succeeded in pairing a British *napi* male (Scotch) with *bryoniæ* bred from parent taken on the Simplon Pass, in 1907, by Mr. Rowland-Brown. From this pairing we obtained 18 males and 17 females and a few pupæ which are lying over the winter. The females are rather remarkable, they are more like *bryoniæ* than *napi*, but the black markings are a deeper black and are more extended than in *bryoniæ*, and the contrast between these markings and the ground colour is greater.

Our experiments were undertaken to see if Mendelian proportions would be obtained, but from this point of view the results are quite negative. So far it would appear that the *bryoniæ* characters are not transmitted by the male, but are transmitted in an exaggerated degree by the female. We hope to have an opportunity of repeating our experiments, as the practical disappearance of *bryoniæ* characters when crossing a male with British *napi* is so unexpected that it needs confirmation.

Life History of Polygonia c-album, imago.—Mr. L. W. Newman read the following note on the life history of the imago of *Polygonia c-album*, and exhibited many examples to illustrate his remarks.

"During the past season I have had ample opportunity of studying the life history of this butterfly, having bred over 2,000 from the ova; we all know the habits of the species, it hybernates as an imago, pairs in the spring, and then lays its

eggs. The larvæ feed up and produce imagines in July: these imagines again pair and lay, and produce the brood which emerges in September and October and go into hybernation; the imagines which emerge in July being as a rule the var. *hutchinsoni*; this I believe is the general idea, and is largely correct, without doubt; but not entirely so. I shall now make two assertions as the result of my experiments for which I offer ample proof: firstly, that the first 12 to 20 ova laid by a hybernated ♀ in the spring are the *only* ova that produce the var. *hutchinsoni*; secondly, the var. *hutchinsoni* is the *only* form which *pairs* and produces the second brood. The first fact is beyond dispute. I have known it to be the case for many years; so has Mr. E. Goodwin of Wateringbury, and I think several others who have bred the species. The second assertion is open to question, and to establish the correctness of it I will go back first to 1902, the original year when I bred this species in quantity.

"Early in the spring I had one ♀ sent to me alive; from her I obtained a nice batch of ova; all the larvæ fed up well, and the first twelve imagines bred I placed in a cage with growing nettles, all being the var. *hutchinsoni*. They paired at once and laid a large quantity of ova; the rest of the brood were killed.

"I next go to 1905, when again I had the species alive—a good many ♀ ♀s, but *all* captured late in the spring; some as late as June, when most of them had laid freely before I received them. Now comes an important point; when the imagines emerged in July I placed the first 40 (about equal sexes) in my cage to pair; the same day one pair was *in cop.*, *both* of the var. *hutchinsoni*, but this was the *only* pairing obtained: the remaining 38 specimens fed well for a few weeks and then retired into the corners of the cage and went to sleep though the weather during August and September was very hot and sunny on most days. Occasionally they came out of their corner to fly and feed, but *very* seldom. In November most of them were still alive, but, through neglect or some unknown cause, all died during the winter or early spring, and two only lived till March 1906.

"On the few sunny days of April this year (1908) hyber-

nated females were on the wing in the Wye Valley, and in one sheltered spot 40 or 50 could be seen during the day. My collector sent me 10 ♀ ♀s and about a dozen ♂ ♂s alive, two of the former proving to be virgins.

"All these ♀♀s laid freely, and by June 20th the first brood was emerging. I might mention here that on July 1st I had 2 ♀♀s that were captured in April still alive and laying, and their offspring out and doing the same thing; so that the two broods (the hybernated ♀♀s and the summer brood) were on the wing simultaneously, and I can also say that not a day has passed between June 20th and November 1st without one or more specimens emerging in my cages; and to-day I have two living pupæ remaining, thus suggesting the possibility of taking *C-album* in 'the wild' on any day from March to November, providing the weather be warm and sunny.

"To resume—the first 65 specimens to emerge in June last were *all* var. *hutchinsoni*. The 66th showed a dark under side and every other specimen (some 800 or so) were also like it; this clearly proving, as I think, that it is only the *first few* eggs laid by the hybernated ♀ in the spring which produce the var. *hutchinsoni*. Of these I placed in my cage 12 ♀ ♀s and 12 ♂ ♂s, and by 5 p.m. there were 12 pairs *in cop.* Two or three days later when those with the dark under-sides started to emerge freely, as a further trial I placed 3 ♀ ♀s and 3 ♂ ♂s in the same cage. But they would not even 'court,' nor would they have anything to do with the ♂ ♂ *hutchinsoni* (still alive in the cage), although the latter appeared quite willing to pair with them. They behaved exactly like the 1905 specimens; and to-day I have 3 of them still alive hybernating, the other 3 having died off for some reason unknown. The last specimen to emerge from pupæ of the summer brood was on August 24th and the first from the autumn brood was on August 18th, so that they overlapped well, and I have had *C-album* in *all* stages at the *same* time during the greater part of the summer.

"The results of the three separate years' experience thus support the view that my deductions as to the life history of this species are well founded on fact."

Mimetic relation between Colaenis telesiphe, Hew., Heliconius telesiphe, Doubl., and Pereute antodyca, Boisd.—Dr. F. A. Dixey exhibited specimens of the genera *Colaenis*, *Heliconius* and *Pereute*, remarking upon them as follows :—

"In his recently-published 'Essays on Evolution,' Prof. Poulton has drawn attention to the close resemblance between the Nymphaline *Colaenis telesiphe*, Hew., and the Heliconine *H. telesiphe*, Doubl. He notes (*l. c.*, p. 334) that the *Colaenis* has departed widely from the usual aspect of its genus, while the *Heliconius* is not far removed in appearance from many of its nearest allies. On these grounds, which are well illustrated by the specimens of both genera here exhibited, we must, as he says, consider *C. telesiphe* the mimic and *H. telesiphe* the model. But, as Prof. Poulton further remarks, there is evidence that the *Colaenis* is the commoner insect of the two; and this circumstance, reinforced by F. Müller's observation of stink-glands in *Colaenis*, favours the Müllerian interpretation of the relation between these insects.

"Accepting Prof. Poulton's view of the case, which indeed it would be very difficult with our present knowledge to controvert, I wish to draw attention to another fact, which also can easily be verified by reference to the present specimens. This is that whereas the upper and under surfaces of the *Heliconius* are much alike and both aposematic, the under side of the *Colaenis* differs from its upper surface in being strongly cryptic, especially in the normal position of rest. If then the relation between these two forms is really Müllerian, we have here an instance of a distasteful butterfly cryptically coloured beneath; an instance in some respects comparable with the well-known cases of *Protogonius*, *Elymnias* and *Eronia leda*. These forms are nearly all mimetic above and cryptic beneath; and while there exists more or less reason for considering them to be at any rate relatively distasteful (see Poulton, *l. c.*, pp. 350–354), the evidence of unpalatability in the present instance is perhaps stronger still.

"A further point of interest is the resemblance between the under side of *H. telesiphe* and that of the Pierine *Pereute antodyca*, Boisd. ♂. There can be little doubt that the under

side of the latter butterfly, so unlike that of the ordinary Pierine, is mimetic in character. But if we attempt to assign it a place in the *telesiphe* combination, we are met by the fact that whereas *C.* and *H. telesiphe* inhabit Ecuador, Peru and Bolivia, *P. antodyca* is only known from Southern Brazil. It may of course be the case that the range of one or more of these species is wider than we are at present aware of; it is also conceivable that they may be linked together geographically by forms as yet unknown to science. But in the absence of any definite information on these points, we must be content to leave it as a puzzle that while the *Pereute* bears only a rough resemblance to Heliconine forms such as *H. besekei*, Ménétr., and *H. erato phyllis*, Fabr., which inhabit the same part of the South American continent with itself, it is strikingly similar in aspect to a *Heliconius* which is separated from it in geographical position.

"A final matter of interest is the appearance on the under side of the hind-wing of *H. telesiphe* of dark nervular and internervular streaks radiating from the base of the wing towards its periphery. This is an aposeme of very widespread occurrence among Neotropical butterflies, being found in Nymphalines, Heliconines, Acræines and Erycinids, besides other groups. In *Pereute antodyca* it is present, though not to a very marked extent; in many other Pierines it is present and strongly mimetic. It is well seen in *Heliconius hortense*, Guér., here exhibited, but is absent from the cryptic under surface of *Colaenis telesiphe*."

Paper.

Mr. Edward Meyrick, B.A., F.R.S., communicated a paper entitled "Descriptions of Micro-Lepidoptera from Bolivia and Peru."

Wednesday, December 2nd, 1908.

Mr. C. O. Waterhouse, President, in the Chair.

Nomination of President, Officers, and Council.

The Secretary again read out the list of nominations.

Donation to the Library.

A cordial vote of thanks was given unanimously to Mr. E. A. Elliott, a Fellow of the Society, for his gift of the parts to date of Wytsman's "Genera Insectorum," and the promise of further parts still to be published.

Election of Fellows.

Mr. Sydney Douglas Crompton of Carlton House, Kew Gardens, S.W., and Mr. W. Parkinson Curtis of Aysgarth, Poole, Dorset, were elected Fellows of the Society.

Exhibitions.

Predaceous Diptera.—Mr. H. W. Andrews exhibited some examples of predaceous Diptera and their victims taken during the year, and a specimen of *Bassus lætatorius*, Fab., ♀, bred from a pupa of the dipteron *Syrphus balteatus*, Dej.

New and rare Coleoptera.—Professor T. Hudson Beare and Mr. H. St. J. Donisthorpe brought for exhibition specimens of *Olophrum assimile*, Payk., a beetle new to the British fauna, taken by them in September 1908, in some numbers out of flood refuse at Nethy Bridge. Mr. Donisthorpe also showed examples of *Trechus longicornis*, Stm., from flood refuse at Kelton, near Dumfries, on September 10th; and of an *Anaspis*, either a new species, or, *A. septentrionalis*, Champion, ♂, taken in woody fungus on Scots firs at Nethy Bridge on September 16th, this being the third specimen, probably, ever taken.

Mr. G. C. Champion expressed his opinion that the *Anaspis* in question did not belong to the species described by himself or by Schilsky, and suggested that it was *A. melanostoma*. Mr

Donisthorpe, however, said that he could not accept this identification on account of the male characters.

Varieties of Abraxas grossulariata.—Mr. G. T. Porritt exhibited forms of *Abraxas grossulariata* bred from wild Huddersfield larvæ during the past year, including (*a*) a pale female in which the usual yellow was entirely replaced by olive-green; (*b*) a very pretty ♀ with broad orange band; and (*c*) two males of the var. *varleyata*, showing how wide a range of variation there is even in the variety; one of the specimens having an inner row of white rays, in addition to the usual outer row, a very rare form.

Mr. L. W. Newman also exhibited an extreme form of *A.* var. *varleyata*, the whole of the fore-wings being coal-black, and only a very narrow white band on hind-wings. The specimen was bred as part of a second brood, November 24th, from typical parents, the former generation being *varleyata* ♀ × type ♂.

Parallel variation of Heliconius forms.—Mr. W. J. Kaye exhibited a fine series of *Heliconius* species from Mapiri River, N. Bolivia, to show the close parallel variation between the very variable forms of *melpomene* with the equally variable forms of *phyllis*. These two species belonged respectively to the two great primary divisions of the *Heliconius* as determined by Riffarth. The forms exhibited were *melpomene amandus*, Gr.-Sm., *melpomene* var. et ab. *aphrodite*, Stgr., and *melpomene penelope* ab. *penelamanda*, Stgr., the *phyllis* forms being *Phyllis phyllis*, Fab., *phyllis* var. et ab. *phyllis*, Gr.-Sm., *phyllis* var. et ab. *amatus*, Stgr., and *phyllis anacreon*, Gr.-Sm. Notwithstanding the splendid recent work on the *Heliconius* by Weymer, Riffarth and Stichel, it was manifestly impossible to decide without breeding what were good species and what were only aberrations.

The use of the term subspecies as employed by Riffarth and Stichel was very ambiguous and did not convey a geographical meaning as employed by Rothschild and Jordan in their more recent work. It was contended that two or more subspecies could not inhabit the same locality, and that either the forms were distinct species or aberrations. As regarding the two species exhibited, Mr. Kaye was of opinion

that the various named forms of each would eventually be proved to be aberrations only.

Variant and rare Coleoptera.—Mr. R. Beck brought for exhibition (*a*) seventy-seven variant forms of *Adalia bipunctata*, L., found in 1894 and 1897 on hop-vines at Alton and Farnham, of which the larva and imago prey on the hop aphis; (*b*) examples of *Lixus paraplecticus*, in appearance resembling small pieces of driftwood, taken 1891, 1893 and 1899, between noon and 3 p.m. on *Sium angustifolium*; and (*c*) a specimen of *Leptura sanguinolenta* taken at Burnside, Southampton, on June 20th, 1891, by sweeping *Umbelliferæ*.

Temperature experiments with Nymphalinæ.—Mr. W. Schmassman showed a case containing specimens of *Pyrameis atalanta*, which had been subjected in the pupal stage to various degrees of temperature. It was noticeable that a low degree produced the "ice-form," some approaching the var. *merrifieldi*, while a high degree tended to convert the scarlet bands of the hind-wing to a creamy-orange.

Mr. F. Merrifield also exhibited a remarkable aberration of *A. urticæ*, bred in October 1906 by Mr. Reuss of Liburg Hall, Ware, from wild autumn larvæ, the pupa having been subjected to strong sunshine, the rays of which, there appeared to be some reason for thinking, produced other effects than merely those ascribable to increase of temperature. There were white spots shaded into violet on the apex of the fore-wings so arranged as to suggest an incipient ocellus as in *V. io* (a specimen of which with the ocellus disintegrated by exposure of the pupa to abnormal temperature was shown for comparison). This arrangement of the white spots was somewhat masked by the brownish colouring of the wing, and was shown more strongly in a photograph which took no account of that colouring. The upper surface of the hind-wings was very different from the normal colouring in *V. urticæ* and had instead the velvety, warm brown-red of *V. io*. The under side, also, was very different from the normal, being much darkened, somewhat like in *V. io*—the hind-wings being entirely black, with a *broad*, darker band.*

* The following is from an explanatory note on the subject which has since been sent by Mr. Reuss. He believes this "*io*-coloured" and "*io*-

Habits of Limenitis.—Professor E. B. Poulton, F.R.S., read a note on the drinking habits of *Limenitis sybilla*, communicated by Mr. Keynes of Pembroke College, Cambridge. A discussion followed in which Mr. H. Rowland-Brown, the Rev. G. Wheeler and other Fellows joined, suggesting from observations made in the forest of Eclépens, Switzerland, and elsewhere, that there is nothing unusual in the settling habit of this species in warm moist woodland places to drink.

Mimicry by Colaenis telesiphe and Belenois thysa, probably Müllerian.—Dr. F. A. Dixey exhibited specimens of *Colaenis*, *Heliconius*, *Pereute*, *Mylothris* and *Belenois*, and remarked on them as follows:—

"It will probably be some time before a complete agreement is reached as to the delimitation of frontier between Batesian and Müllerian mimicry. One character that has been suggested as a criterion is the possession of cryptic colouring on the under surface. It has been argued, as by Mr. Shelford, that no insect is likely to be both aposematically and cryptically coloured at the same time; and that therefore any mimic, such as *Protogonius*, whose under side is adapted for concealment, must be of the Batesian and not of the Müllerian description. I have myself always been doubtful as to the value of this criterion, and I have reason to know that my doubts are shared by Prof. Poulton.

"It will be remembered that at the last meeting I showed that *Colaenis telesiphe*, Hew., though undoubtedly a mimic of *Heliconius telesiphe*, Doubl., was cryptically coloured beneath. But the available facts as to the relative frequency of the two species, as stated by Prof. Poulton, make it difficult to apply Batesian principles to the interpretation of the present case. Since that meeting, Mr. W. F. H. Rosenberg has kindly furnished me with some additional details as to the

form" variety of *A. urticæ—A. urticæ* ab. *ioformis*—to be the result of a potentially inherent *io*-form tendency yet found latent in some individuals of autumn broods, and brought to active life by the direct sunrays which, —if *not met* by the said creative tendency, would *only* either blotch, dull or brighten the image, leaving it otherwise normal. During hot autumn seasons—for instance September 1907 and the October of this year—this *io*-form variety might have occurred in the natural state and possibly examples of it may have been captured. Artificially it might also be bred by other means than sunrays—the said creative tendency being the first and chief factor.

occurrence of the two species, which tend to strengthen the conclusion that the *Colaenis*, so far from being relatively rare, as we should expect of a Batesian mimic, is probably commoner than the *Heliconius*. Collections received by Mr. Rosenberg from three different localities contained altogether 76 of the *Colaenis* and 73 of the *Heliconius*. The numbers were distributed as follows :—

	El Porvenir.	Pozuzo.	Huanca-bamba.
Colaenis	12	32	32
Heliconius	56	—	17

There was no reason, so far as Mr. Rosenberg is aware, for the collectors to have given more attention to one species than to the other.

"There appears to be no doubt that the *Colaenis* is the commoner insect in dealers' stocks. Mr. Rosenberg has also sent me some figures which show that one dealer charges nearly three times as much for the *Heliconius* as for the *Colaenis*; another charges twice as much; and a third has a stock of the *Colaenis*, but does not list the *Heliconius* at all.

"It is hardly to be expected that a Batesian mimic should be as common as, and even less to be expected that it should be commoner than, its model; still more improbable does it seem that the Batesian mimic should occur in places from which its model is absent. This is one reason why I am inclined to think that the mimicry of *Mylothris agathina*, Cram., by the dry-season form of *Belenois thysa*, Hopff., is Müllerian rather than Batesian. In a morning's collection at Congella, near Durban, Natal, in 1905, Dr. Longstaff and I found *B. thysa* not uncommon; but *M. agathina* was not to be seen, though we were on the look-out for it for purposes of scent-extraction. This observation is confirmed by a record in the Entomologist, vol. xli, 1908, p. 31, where Mr. H. W. Simmonds says that at Stella Bush, Berea, Durban, on March 5, 1907, 'one of the commonest butterflies was *Pieris* [*Belenois*] *thysa*, but, strange to say, its model, *Mylothris agathina*, was quite scarce.' *Mylothris agathina* is no doubt generally the commoner form, but there are evidently times and places when it has to yield in point of frequency to its mimic *Belenois thysa*."

ANNUAL MEETING.

Wednesday, January 20th, 1909.

Mr. C. O. Waterhouse, President, in the Chair.

Mr. R. Wylie Lloyd, one of the Auditors, read the Treasurer's Balance Sheet, showing a balance of £10 19*s* in the Society's favour.

Mr. H. Rowland-Brown, one of the Secretaries, then read the following

Report of the Council

During the Session 1908–1909 seven Fellows have died, seven Fellows have resigned, forty new Fellows have been elected, one Fellow has been made an Honorary Fellow, the names of seven Fellows have been removed from the list, and that of one Fellow restored.

While last year we were able to record a number of elections in excess of any previous year of the Society, we have the pleasure to announce that this figure has again been surpassed during the present Session. It is also a gratifying fact that the attendance at the Ordinary Meetings of the Society continues to improve, and that a comparatively large number of Fellows take an active interest in this part of our work. We have also again added to our roll a number of entomologists resident in the British Colonies, men distinguished as well in the theoretical as in the practical side of our science.

At present the Society consists of twelve Honorary Fellows, and five hundred and nineteen Life and Subscribing Fellows, making a total of five hundred and thirty-one in all, and showing an increase of over a hundred in the past ten years.

The Council has devoted much time and attention to the finances of the Society, but the proposal to increase the amount of the Life Composition from £15 15*s*. to £21, when put before the Society, was lost by a narrow margin. Meanwhile, the policy of economy, outlined in our report last January, has been pursued steadily, and with this object further in

view, the Council have appointed a special Publications Committee, consisting of the executive officers of the Society for the time being, with the assistance of Dr. T. A. Chapman, M.D., F.Z.S., Mr. J. E. Collin, Mr. E. Saunders, F.R.S., Mr. R. Shelford, M.A., F.L.S., and Mr. J. W. Tutt, who will act as referees of papers submitted by authors, and advise the Council on all matters connected with the Society's publications.

The Transactions for the year form a volume of six hundred and seventy-three pages, containing twenty-five Memoirs by the following authors: Mr. Gilbert J. Arrow, F.E.S., Dr. T. A. Chapman, F.Z.S., M.D. (three), Dr. F. A. Dixey, M.A., M.D., Mr. Hamilton H. Druce, F.L.S., F.Z.S., Mr. C. J. Gahan, M.A., Dr. J. L. Hancock, M.D., Mr. Dukinfield Jones, F.Z.S., Dr. G. B. Longstaff, M.D. (three), Mr. G. A. K. Marshall, F.Z.S., Mr. J. C. Moulton, F.E.S., Professor E. B. Poulton, D.Sc., M.A., F.R.S. (two), the Rev. K. St. Aubyn Rogers, M.A., Mr. Edward Saunders, F.R.S., Mr. Hugh Scott, B.A., Col. C. Swinhoe, M.A., F.L.S., Mr. Rowland E. Turner, F.E.S., and Mr. W. Wesché, F.R.M.S. (two).

Of these papers, eleven refer to Lepidoptera, and two to the special subject of Müllerian mimicry and Diaposematism in connection therewith, two to Diptera, one to Rhynchota, one to Orthoptera, three to Hymenoptera, and two to Coleoptera, the rest being papers of general entomological interest.

The Memoirs referred to are illustrated by thirty-four plates, and three more are included in the Proceedings, making thirty-seven in all, of which six are coloured. Plates I, II, III, XXI have been paid for by the Society. The cost of Plate XIV was given by Dr. T. A. Chapman, of Plate XXIV by Professor E. B. Poulton, F.R.S. The blocks for Plates VIII–XIII, XV–XVII, XIX, XX, and Plates A, B, and C, in the Proceedings, were also given by Dr. Chapman (fourteen in all), and the blocks for Plates XXIII and XXV–XXXIV (eleven in all) by Professor Poulton.

The quality and length of the Proceedings is well maintained, and they include a number of short papers on all branches of entomological science.

Much to our regret the amount offered in grant to the Travel Fund was not applied for, but Mr. Merrifield, the generous donor, has intimated that he is willing to renew his donation, and it is to be hoped, therefore, that Fellows anxious to pursue their studies abroad will avail themselves of the opportunity.

The Society was invited to send a delegate to the Darwin-Wallace Celebration of the Linnæan Society, and was represented by our President, Mr. C. O. Waterhouse; also to the Celebration of the Fiftieth Anniversary of the Oxford University Museum, when one of the Secretaries, Commander J. J. Walker, R.N., attended on our behalf. The Society has also been asked to send a representative to the Charles Darwin Commemoration at Cambridge this year, and we have requested our President-elect, Dr. F. A. Dixey, to attend in our behalf.

For the first time in our history, we are able to report a Conversazione organised by the Society, and held in the rooms of the Civil Service Commission at Burlington House, kindly placed at our disposal by the First Commissioner of Works. About three hundred Fellows and their guests attended, the expenses being defrayed by the contributions of Fellows who subscribed their names to the Guarantee Fund, and by the sale of tickets. Owing, however, to the death of several subscribers a small sum remains chargeable to the general funds of the Society. Lord Avebury also most kindly made a donation. It is to be hoped that similar meetings may be held in the future; if not every year, at all events at short intervals.

The Treasurer reports that the subscriptions for the year, as shown by the Balance Sheet of the Society, are about £30 in excess of those for 1907. The admission fees, amounting to £46 4*s.*, again show an advance on previous years. There is also a satisfactory increase in the sale returns for the Society's publications, the cash balance in favour of the Society being £10 19*s.* 6*d.* in all.

The Librarian reports that the Library has been particularly well patronised for the purposes of reference and study, and that 278 volumes have been issued for home reading.

Twenty-six volumes, including eleven of Wytsman's "Genera Insectorum," and ninety-eight pamphlets have been added to the shelves, as well as the usual periodicals.

Entomological Society of London,
11, Chandos Street, Cavendish Square, W.
January 20th, 1909.

The Secretaries not having received any notice proposing to substitute other names for those contained in the list prepared by the Council, the following Fellows constitute the Council for 1909–10:—George C. Champion, F.Z.S., Dr. T. A. Chapman, M.D., F.Z.S., Dr. Frederick Augustus Dixey, M.A., M.D., Albert Harrison, F.L.S., F.C.S., Selwyn Image, M.A., Albert Hugh Jones, Dr. Karl Jordan, Ph.D., Dr. George Blundell Longstaff, M.D., Hugh Main, B.Sc., Guy A. K. Marshall, Professor E. B. Poulton, D.Sc., M.A., F.R.S., Henry Rowland-Brown, M.A., Robert Shelford, M.A., F.L.S., C.M.Z.S., Rowland E. Turner, James W. Tutt, Commander James J. Walker, M.A., R.N., F.L.S., Charles Owen Waterhouse.

The following were also elected as officers:—President, Dr. F. A. Dixey, M.A., M.D.; Treasurer, Albert Hugh Jones; Secretaries, H. Rowland-Brown, M.A., and Commander J. J. Walker, M.A., R.N., F.L.S.; Librarian, G. C. Champion, F.Z.S.

The Balance Sheet and Report having been adopted, Mr. C. O. Waterhouse, the President, delivered an Address. A vote of thanks to the President for his Address, and for his services as President during the past year, was proposed by Dr. F. A. Dixey, seconded by Mr. G. H. Verrall, and carried unanimously. The Rev. F. D. Morice then proposed a vote of thanks to the other officers of the Society. This was seconded by Mr. R. Wylie Lloyd, and carried unanimously. The President, Mr. A. H. Jones, Mr. H. Rowland-Brown, and Commander J. J. Walker replied.

ENTOMOLOGICAL SOCIETY OF LONDON.

Balance Sheet for the Year 1908.

Receipts.	£	s.	d.
Balance on hand, 1st Jan., 1908, and at Bankers ...	6	7	11
Subscriptions for 1908 ...	430	10	0
Arrears	23	2	0
Admission Fees	46	4	0
Donations	23	3	6
Sales of Transactions ...	75	14	9
Interest on Investments:—			
Consols £21 19 5			
Westwood Bequest:—			
Birmingham, 3 per cent. ... 6 16 6			
	28	15	11
Subscriptions in Advance	17	17	0
Life Compositions	15	15	0
	£667	10	1

Payments.	£	s.	d.
Printing Transactions, etc.	290	4	1
Plates, etc.	116	1	4
Rent and Office Expenses	189	16	6
Books and Binding	42	12	2
Subscriptions in Advance, per contra carried to 1909	17	17	0
Balance in hand and at Bankers	10	19	0
	£667	10	1

Assets.	£	s.	d.
Subscriptions in arrear considered good, say ...	50	0	0
Cost of £929 16*s.* 5*d.* Consols. Present value at the price of 83⅞ on 2nd Jan. 1909, £779 17*s.* 9*d.*	902	8	0
Cost of £239 12*s.* 4*d.* Birmingham 3 per cents. Present value at the price of 91 on 2nd Jan. 1908, £218 0*s.* 11*d.* ...	250	0	0
Balance in hand	10	19	0
Additional Assets;—			
Contents of Library and unsold stock.			
	£1,213	7	0

Liabilities.

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A. Hugh Jones, *Treasurer*,
10th January, 1909.

THE PRESIDENT'S ADDRESS.

Ladies and Gentlemen,

It seems but a short time since I had the privilege of addressing you, but another year of our Society's work is completed. Our Meetings have been well attended, and I think no one has ever gone away from them feeling disappointed, as they have always been interesting and helpful.

In July last there was at the Linnean Society a celebration of the fiftieth anniversary of the reading at that Society of the joint paper on the origin of species by Darwin and Wallace. I had the honour of representing this Society on that occasion, and I shall not soon forget it, for it was a striking demonstration of the veneration in which these Scientists are held.

Our volume of Transactions is again large, and one cannot help wondering whether some of the most important papers in it would ever have been written if it had not been for the groundwork laid by those two men in the paper alluded to.

I have to put on record the deaths of seven Fellows during the past year, viz.—Frederic C. Lemann, Francis F. Freeman, Thomas F. Furnival, Herbert Goss, Colonel C. T. Bingham, T. Maddison, and John A. Clark.

Herbert Goss joined our Society in 1874. He died on February 16th, 1908. For 35 years he was in the Solicitor's Office of the General Post Office. He took great interest in Natural History generally, but was more especially devoted to British Lepidoptera, of which he formed a most valuable collection. He also had a very complete herbarium of British plants. He contributed a series of papers on Fossil Insects to the "Entomologists' Monthly Magazine," which have been since reprinted with the title "The Geological Antiquity of Insects," which is a most useful *résumé* of this branch of

science. He edited the Entomological sections of several volumes of the "Victoria History of the Counties of England," and he himself contributed valuable accounts of the Lepidoptera of several counties. He held the office of Secretary to our Society for eleven years from 1886, and again from 1901 to 1905; he was Vice-President of the Society in 1906. His long tenure of office was marked by great tact, good nature, and ability. He ought to be always gratefully remembered for the active and useful part he took in the protection of the New Forest, when in 1892 it was threatened with spoliation. Mr. Goss was certainly a landmark in the history of the Entomological Society.

Frederic C. Lemann joined this Society in 1883. He died in March 1908. As he did not reside in London he was known only to a few of the Fellows of this Society, but his friendship and companionship were greatly valued by those who knew him. Although he made no collection himself, he was a keen collector of butterflies, which he gave to his friends. He was well acquainted with Switzerland and other parts of the Continent, and may be said to have introduced Corsica to British entomologists. He wrote various papers on his continental excursions, but will perhaps be best remembered for his translation of Dr. H. Frey's "Die Lepidopteren der Schweiz."

Francis Ford Freeman died on the 6th of April, 1908. He was born December 16th, 1847. He joined the Entomological Society in 1883. He made a very good collection of British butterflies, most of which he caught himself. He had also a separate collection of European butterflies, in the formation of which he was assisted by Mr. F. C. Lemann and Mr. W. Nicholson. On one occasion, in 1885, he caught a perfectly fresh specimen of *Anosia plexippus*. As he resided at Tavistock he was unfortunately known only to a few London entomologists.

Lieut.-Colonel C. T. Bingham died on October 18th, 1908. He was born April 16th, 1848, and joined this Society in 1895. He was attached to the Bengal Staff Corps, and was Conservator of Forests in Burma. While in India and Burma he devoted much attention to Natural History, and collected large numbers of specimens which he distributed liberally to

Museums and private individuals. His early papers refer to birds, and were published in "Stray Feathers" from 1876 to 1881. For some years past he devoted himself more especially to insects, particularly Hymenoptera and Lepidoptera. He wrote numerous papers on the former, and in 1897 and 1903 he contributed two volumes on this Order to the "Fauna of British India," which were followed in 1905 and 1907 by two volumes relating to the Butterflies. On the death of Dr. Blanford he succeeded him as editor of the "Fauna." During the last few years he had been engaged in arranging the general collection of Aculeate Hymenoptera in the British Museum, and had completed the *Formicidæ*, *Mutillidæ*, *Scoliidæ* and *Pompilidæ*. He combined with a strong determination, a gentleness, kindness and thoughtfulness for others that made him more than respected. He was often appealed to at our meetings on account of his wide experience as a field entomologist.

John Adolphus Clark died on December 16th last at the age of 66. He joined this Society in 1886. He was at one time President of the old Haggerston Entomological Society, and was afterwards for some years President of the City of London Entomological Society. He contributed many interesting notes to the "Entomological Record," some of them being accompanied by useful illustrations. He devoted considerable trouble to the study of *Peronea cristana* and its numerous varieties. His paper on this species is accompanied by a plate in which many interesting forms are figured.

In turning over in my mind what subject I might take for my Address this evening, it occurred to me that I might say something about the claws of insects, this being a matter that would be of general interest. I do not propose to write a treatise on the structure of these claws, but rather to suggest a subject for inquiry and research. I must, however, to a certain extent, include the whole tarsus, as the claws are only part of a somewhat complex instrument. I need not say very much about the tarsi. The most primitive tarsus probably consists of five joints, but the number is often reduced to four, three, two, or even one. The undersides of the tarsal joints

are sometimes furnished with fleshy pads, as in the *Locustidæ*; with a membranous terminal lobe as in the *Buprestidæ* and other Coleoptera. Sometimes there is a line of stiff hairs or bristles on each side, or the surface is beset with bristles all over, or is hairy or velvety. At the apex of the terminal joint there are two claws varying greatly in shape and structure. Occasionally these are absent. Between the claws there is a more or less fleshy lobe or pad which assumes various shapes, and is sometimes divided into two, and has received various names. For my present purpose I will refer to it as the *pulvillus*.

Primarily the claws are only bristles, but they have been modified to perform certain functions. They are often immovable, so that they are described as connate, divergent, or (when they are at right angles to the axis of the tarsus) divaricate. Perhaps quite as often they are to a certain extent movable, but they are not controlled directly by muscles, but by another method. A noteworthy example is the large claw of some of the Rutelid Coleoptera, which is capable of being bent back on the tarsal joint, as the blade of a penknife is closed in its handle, so as to make a perfect grasping instrument. In the Melolonthid genus *Ancistrosoma*, both claws turn back equally. In the curious Neuropterous genus *Bittacus*, which has but a single large claw, this acts in the same way.

The claws in a large number of insects are quite simple, more or less curved, of various thicknesses at the base, generally pointed at the apex. Sometimes on the underside of the claw there is a tooth which may be in any position; occasionally there are two teeth, but this is not common. When later on I refer to toothed claws, I mean those with a single tooth. In some instances there is beneath the basal part of the claw a vertical, compressed, blade-like plate or enlargement. Sometimes this is confined to the base, at others it extends nearly to the apex, leaving only a narrow incision between it and the tip of the claw. This is referred to as an appendiculate claw. Another form of claw is what is described as bifid, that is, as if a cut had been made at the tip with a sharp knife, thus making two points. The two points may be one below the other, but very often the incision is slightly lateral, so that

one point is inside the other. The incision is sometimes very slight, in other cases it reaches nearly to the base of the claw.

There are numerous cases in which the claws are pectinate, that is to say, toothed like a comb.

The claws of *Cantharidæ* require special mention. These insects appear to have four claws. This is due to the fact that each claw roughly resembles the blades of two knives placed side by side and fastened together by their bases, the outer blade being more slender than the inner one, and often very flexible. In some genera these two blades seem to be inseparable, but in others, such as *Cerocoma*, they have a slight separate movement. It is not my purpose now to discuss what this outer blade is, but it is, I think, generally admitted that it is not part of the claw. It may, however, in conjunction with the real claw serve the purpose (if there be any) of a deeply bifid claw. In some genera the inner, or real claw is simple, in others it is pectinate.

Insects with toothed claws.

As examples of toothed claws I would mention among the Coleoptera, *Melolontha* and numerous others in the same family and *Corynodes* among the *Eumolpidæ*.

In the Hymenoptera certain species of *Pompilus*, *Salius*, and *Megachile*.

In the Neuroptera, *Cordulegaster* and many other Dragon-flies.

Sometimes the tooth instead of being acute is truncate at the apex and has its sides somewhat parallel. This occurs in the Melolonthid genus *Sebaris* and among the Hymenoptera in the genera *Pompilus* and *Nomada*.

Insects with appendiculate claws.

Appendiculate claws are not very uncommon in the Coleoptera. Good examples are *Bytturus* among the Clavicorns, and *Oocamenta* and its allies among the Melolonthidæ. In a more elongate form it is seen in *Lobonyx* and *Henicopus* among the Malacoderms. Among the butterflies *Lycæna* has it in almost identically the same form as in *Bytturus*.

Insects with bifid claws.

Claws which are bifid at the apex are perhaps more common

than those with a tooth only. A large number of Coleoptera of the families *Melolonthidæ* and *Rutelidæ* have this form. The *Rutelidæ* differ from the *Melolonthidæ* in having the two claws of unequal size, the outer one being the larger. Sometimes both these claws are simple, but in many cases the larger claw of the anterior tarsi is bifid. In some species the larger claw of all the tarsi, and in some both claws of all the tarsi are bifid. The bifid claw occurs in the *Melolonthidæ* in such genera as *Diphucephala*, *Macrodactylus*, *Chaunanthus*, *Chasmatopterus*, and many others, but both claws are of the same size.

Many other Coleoptera have bifid claws. Dragon-flies of the genus *Macromia* and its allies and, I believe, all the *Agrionidæ* have this form of claw, although it is often very slight. It is very slight in *Mantispa*. All the *Pieridæ* have the claws bifid, and so have the *Tenthredinidæ*. Among the wasps the genera *Rhynchium*, *Odynerus*, *Eumenes* and *Synagris* may be mentioned. In all these the two points are one below the other, or nearly so. In some species of wasps of the genus *Salius*, *S. basalis* for example, the lower point is inside the upper one, and this is so in most of the bees that have bifid claws, such as *Bombus*, *Apathus*, *Anthophora* and *Anthidium*. In the Longicorn genus *Amphionycha* nearly the same form occurs, but here the claws are more curved.

Having briefly mentioned the different forms of claw, let us now inquire whether any particular form is associated with any special habit of the insect. Is this difference in the claws merely the result of heredity without any special object, or is there any evidence to show that a special form of claw is adapted to some particular mode of life; that is to say, has it been developed to meet some particular need?

In the Coleopterous genus *Uroplata* the elytra are furnished at the apex with spines and teeth of various shapes, and in no two species are they exactly alike. Broadly speaking, these spines may be of service to the insect, but it is hardly probable that each particular modification is specially advantageous to the species which has it. I suggest as a subject for inquiry, ARE THE CLAWS OF INSECTS IN THE SAME CATEGORY?

It is difficult to imagine that the often remarkable form of the claws has no special utility, but when trying to find to what purpose a particular form is adapted, one is met with what seems to be contradictory evidence on every side. Of course a claw might be suitable for a particular mode of life, and it does not necessarily follow that all insects that have similar habits would have the same form of claw. It is remarkable how Nature having shown you in one insect an organ beautifully adapted to perform some special function, proceeds to show you in another that she can do perfectly well without it. For example, *Dytiscus* and *Notonecta* and other water insects have the hind tarsi formed most perfectly for swimming, but *Litodactylus*, a weevil, which from its appearance and the very ordinary form of its legs one would never suspect of going near water, nevertheless lives in it and swims rapidly.

Let us briefly examine this question in the light of the examples I have just given. Take, for instance, insects constantly frequenting flowers. Mr. Champion in our "Transactions" (1907, p. 164), in an account of his captures in Spain, gives a list of Coleoptera found "on flowers in open spaces." They are "Clytids, Lepturids, Malachiids, Mordellids, Œdemerids, *Cryptocephalus*, *Omophlus*, *Cerocoma*, *Coryna*, *Lobonyx*, *Trichius*, *Anisoplia*, *Chasmatopterus*." Of these the Clytids, Lepturids, Œdemerids, *Cryptocephalus* and *Trichius* have simple claws; *Anisoplia* and *Chasmatopterus* have bifid claws; Mordellids may be either simple, toothed or pectinate; *Omophlus* has them pectinate, and *Lobonyx* appendiculate; *Cerocoma* and *Coryna* are *Cantharidæ* with quasi-bifid claws. Thus we have in this one little list every form of claw, quite half the insects having them simple. Add to these those that we know by experience would be associated with them, numerous Diptera, *Ichneumonidæ*, *Tenthredinidæ*, Wasps and Bees. Nearly all the Diptera, the *Ichneumonidæ*, and some of the wasps have simple claws. The *Tenthredinidæ* have them bifid, as have also many of the bees, although some of these, such as *Osmia*, have them simple, and *Megachile* has them toothed. There is nothing here to point to any particular form of claw being specially adapted to insects frequenting

flowers. But it may be said that flowers attract all sorts of insects.

Let us look at it from a rather different point of view. The bees of the genera *Bombus*, *Apathus*, *Anthophora*, and *Anthidium* have bifid claws, and all are frequenters of flowers and are more or less dependent upon them for their existence. But exactly the same form of claw is seen in some wasps of the genus *Salius* (e. g. *S. basalis*), which are among the most predaceous insects, storing their nests with spiders, the larger species attacking and killing even the large *Mygalidæ*. Again, although *Bombus* and *Apathus* are both frequenters of flowers they are somewhat different in their habits in other respects, *Bombus* forming its nest on or under ground and storing it with pollen, while *Apathus* lives as an inquiline in the nest of the *Bombus*. *Bombus* and *Salius*, however, have at least this in common, that they both build nests. The building of nests and formation of cells is, however, done chiefly with their mandibles, so that the form of the claw is not likely to be due to this cause. The species of *Crabro* and *Cerceris*, both of which store their cells with other insects, have simple claws. *Pompilus*, which stores its cells with spiders, has toothed claws. The species of *Odynerus* which form cells in bramble stems and any convenient hole and store them with larvæ, have bifid claws, and so has *Eumenes*, which forms mud cells in which they store caterpillars.

Quite apart from the question of the habits of bees and wasps, there is the fact the toothed and bifid claws are found in other Orders. The toothed claws of *Pompilus*, *Pepsis*, *Megachile* and others can be very well matched in Coleoptera of the family *Melolonthidæ*, and, as I have already mentioned, in certain Dragon-flies, insects with totally different habits. Again, the bifid claw occurs in many Coleoptera, the Longicorn genus *Amphionycha*, for example. These are fond of resting on flowers. I do not know where they deposit their eggs, but it must be in dead or dying wood or in the stems of plants. But the species of *Glenea* which so much resemble them, and which so far as I can ascertain are also frequenters of flowers, and whose larvæ no doubt live in similar places, have at least in the females simple claws, as indeed the vast majority

of Longicorns have. So far as one can see, therefore, there is nothing in the habits of *Glenea* and *Amphionycha* to account for the difference in their claws.

It has been suggested to me that one of the reasons why so many Lamellicorn Coleoptera have toothed or bifid claws is that they are arboreal in their habits, the ground beetles, Geodephaga, having them simple. It is certainly true that the Geodephaga, generally speaking, have simple claws, although there are exceptions that I shall have to allude to later on; but all the *Cetoniidæ* and *Dynastidæ*, which comprise about half of the Lamellicorns, have simple claws, and it cannot be said that they are in any way ground beetles. The *Cetoniidæ* and *Trichiidæ* are commonly found on flowers and shrubs, and so are some of the *Dynastidæ*. There may be, however, some difference in their habits in other ways. The larvæ of *Melolonthidæ* are, so far as I know, root-feeders, whilst the larvæ of *Cetoniidæ* and *Trichiidæ* live more in decaying wood. I do not know much of the habits of exotic *Dynastidæ*, but some species, at least, are root-feeders, like the *Melolonthidæ*. The evidence in favour of the toothed or bifid claws of the *Melolonthidæ* being accounted for by their arboreal habits is not, therefore, very strong.

We may now look at raptorial insects. First of all we may take the Dragon-flies, *Odonata*. I have already had to refer to these. A large number have bifid claws, the others have them toothed. Both forms of claw can be very fairly matched in the *Rutelidæ* or *Melolonthidæ*. I have already referred to the raptorial wasps of the genera *Pompilus*, *Salius* and *Pepsis* which have toothed or bifid claws, but other genera which prey on insects such as *Cerceris* and *Crabro* have them simple. The Diptera of the families *Asilidæ* and *Empidæ* which are predaceous have simple claws, as have also the Neuroptera of the families *Myrmeleonidæ*, *Ascalaphidæ* and *Nymphidæ*.

I will now say a few words about pectinate claws. To an entomologist these are often beautiful objects under the microscope. The claws are sometimes rather straight, sometimes strongly curved, and, of course, the number of teeth

varies very much. In this case, at least, one would expect there must be some object in this comb; but so far, I have been unable to find any evidence that it has any special advantage over the simple claw—closely allied species with apparently the same habits having them simple and pectinate. One curious thing connected with this form of claw is that it appears suddenly, as it were, in the midst of species which have simple claws, and the species with simple and pectinate claws closely resemble each other in appearance. *Ophion*, for example, has pectinate claws, but *Paniscus*, which so closely resembles it, and all the allied Ichneumonidæ have them simple.

Again, in the Chrysididæ, *Homalus auratus* has pectinate claws, but *Holopyga*, which is allied to it, has only a slight tooth. In the Carabidæ, *Dendrocellus*, a graceful green insect, with narrow thorax and more or less yellow legs, has pectinate claws, but the next genus *Drypta*, which might be mistaken for it, has them simple. In another group of Carabidæ, *Orthogonius*, a flat, broad, oblong, brown insect has pectinate claws, but *Apsectra*, which closely resembles it, has them simple.

In the Elateridæ *Adrastus pallens* has pectinate claws, and *Agriotes pallidulus*, which might be mistaken for it, and indeed was mistaken for it by old authors, has them simple. All these stand out more or less isolated. The only case known to me where there is anything like a passage from the simple to the pectinate form occurs in the Carabidæ allied to *Dromius*. Some species have them simple, *Lionychus quadrillum* for example. Some have them slightly pectinate, that is to say, with very short teeth, not much more than serration, others have them strongly pectinate. *Demetrias atricapillus* has them pectinate, *Aëtophorus* has them simple. Again, many species of *Lebia* and its allies have pectinate claws, whilst others have them simple. In the Lamellicorns, *Listronyx* has them pectinate.

In the Dascillidæ, *Odontonyx* and *Paralichas* have the claws beautifully pectinate, and they are so in the Elateridæ of the extensive genus *Melanotus* and in *Aptopus*. All the Heteromera of the family *Cistelidæ* have the claws pectinate. This is the only case known to me where all the members of a

family have this form of claw, but I have my suspicions that it is not a natural family. The genera *Atractus*, *Cistela* and *Prostenus* are certainly strikingly dissimilar. Some genera of *Cantharidæ* have pectinate claws, others have them simple.

In the *Cassididæ*, *Aspidomorpha* and *Ctenochira* have them pectinate. Lastly, I have to mention the Neuropterous genus *Panorpa*. We have, therefore, to inquire if these insects have anything in common. Firstly, there are the parasitic Hymenoptera *Ophion* and *Homalus*, belonging to totally distinct families. Then we have carnivorous *Carabidæ* and examples among the *Dascillidæ*, *Elateridæ*, *Cistelidæ*, *Cantharidæ*, *Cassididæ* and the predaceous *Panorpa*. It is a curious assemblage. It is difficult even to suggest a reason why *Ophion* should require pectinate claws whilst *Paniscus* has them simple, especially as they are both parasitic on the same insects; or why *Homalus* should have them pectinate whilst its nearest allies have them nearly simple. It has been suggested that the *Carabidæ* which have this form of claw frequent shrubs. This is true of some of them certainly, but so far as Entomologists are concerned, *Dromius* is generally found under bark, on the ground, or at the roots of grass. Some of the Lebias have been found on shrubs, but they are generally in moss or at the roots of grass. Other *Carabidæ*, however, with simple claws may be found on trees. Most Lepidopterists know that species of *Carabus* and *Anchomenus* may be found at their sugar, and it is not for the sugar only that they are there. *Calosoma* is constantly found in broad daylight in oaks and birch, where they go in search of caterpillars. Any one who has seen this beautiful insect run down the trunk of an oak will not soon forget it. How this insect manages to hold on to the smooth birch twigs is rather a mystery. *Silpha quadripunctata* is another insect with simple claws constantly found on oak-trees. In the *Elateridæ* the percentage of those that have pectinate claws is small. If you go into any wood and beat the trees, the species you would probably find are *Lacon murinus*, *Athous*, *Agriotes pallidulus* and *acuminatus*, *Dolopius marginatus* and *Corymbites holosericeus*. All these have simple claws. Sweep the grass and you will get other species of *Agriotes*, but with them perhaps *Adrastus* with its pectinate claws. The pectinate-clawed

Melanotus you may dig out of rotten stumps or sweep from herbage or beat off trees. And this is the way you would also find *Athous* or *Elater* with their simple claws. The *Cistelidæ* are all, I think, found on trees and shrubs, the larvæ of many of them living under bark. The *Cantharidæ* are many of them at least parasitic. One would have to know more of the habits of these than I do before venturing to suggest any reason for the great difference in their claws. All the *Cassididæ*, the majority with simple claws and the minority with them pectinate, live on plants, both in the larva and perfect state, there being apparently no difference in their habits. Our Scorpion-fly *Panorpa* is predaceous, and is common on trees or is seen flying from one plant to another. Its larva lives in rotten wood. The allied genus *Bittacus* has simple claws, but I have already alluded to them on account of their curious prehensile character. *Harpobittacus australis*, Mr. Froggatt states, is found hanging about bushes, the hind legs hanging loosely down ready to strike out the moment a fly comes within range. The long flexible tarsi fold round the captive with the stout spines transfixing it, the legs are drawn forwards under the head so that it can press its rostrum into its victim. In the Museum there is a specimen of this insect with a small caterpillar in its hind tarsus.

There is a little group of insects which I must not omit to mention, the *Hippoboscidæ*. The claws in these flies vary very much; they are somewhat complex, combining the toothed and appendiculate claw in one. The insects live among the feathers of birds and in the fur of mammals. If any claw has been developed to suit the habits of an insect, it is surely here. One notes, however, that fleas which have the same habits have simple claws.

I think I have said enough to show that the question as to whether these complex claws have been developed to suit the habits of the species is still an open one. I have shown that very closely allied species have totally different forms of claw; that insects with quite different habits have the same form of claw; that species with different forms of claw have apparently identical habits. If the pectinate claw, for example, has no special connection with the habit of the insect, but is only

an inherited structure like the spines at the apex of the elytra in *Uroplata* already alluded to, then we should expect to find indications of it in closely allied forms, but this is not the case. If it *is* associated with some habit of the insect and is useful, then it must be useful in more than one way, as insects of totally different habits have it. And if, generally speaking, it is a useful form of claw, then it is remarkable that so few insects have developed it.

Another point which suggests itself to one's mind is that perhaps the reason why so few insects have developed complex claws is that they are rendered unnecessary by the sticky hairs or adhesive pads on the undersides of the tarsi. We find, however, that many insects which have these sticky hairs have also bifid or pectinate claws, such as *Amphionycha*, *Corynodes*, *Ctenochira*, *Pieris*, *Lycæna* and many others which can walk on glass perfectly well. Among those which I have tried on clean vertical glass I may as well just mention here that all the *Ichneumonidæ*, *Trichoptera*, *Tineina*, and all the Diptera (except perhaps *Tipula*) could run freely on it, but the *Syrphidæ* were uncertain. *Halictus* and some other small bees were fairly at home, but *Bombus* and *Apathus* were quite helpless, as were also *Colias* and *Vanessa*. *Adrastus*, the little Elaterid that I have mentioned among those with pectinate claws, was very uncertain.

Some insects when resting only touch the object they are standing on with the extreme tip of the tarsus. I noticed that when *Pieris* was resting on the glass it was holding on only by the apex of the pulvillus which projected just beyond the tip of the claws; it needed a magnifying glass to see this. *Plusia gamma*, which seemed to be holding, was found, when looked at with a magnifying glass, to be slipping very slowly all the time, but it kept its position by darting forward its right foot, and when this had slid down some distance the left one was shot forward, and so on. I have already alluded to the necessity of taking into account the adhesive hairs. The spines on the tarsi of fossorial Hymenoptera and other insects must also not be forgotten. I should imagine that these spines would act somewhat in the way of a thumb. When settling on any object the claw would probably be the first

thing to come in contact, then as the tarsus was lowered the sharp spines all directed forwards would touch and pull in an opposite direction to the tip of the claws and thus clinch it. But this is just where careful observation is needed, and it is this I ask for.

I think it a happy thing that some of the Fellows of this Society have been foremost of late in looking into the habits of insects. But there are so many ways of observing, so many kinds of insects to notice, whilst it is also necessary that the observations should be made with some definite object in view.

I am a firm believer in making a particular subject your study. The excellent work done by Professor Poulton and Dr. Dixey in connection with mimicry; the valuable contribution to science resulting from Mr. Merrifield's experiments on the effect of temperature on coloration; the interesting discoveries made by Mr. Donisthorpe in his study of insects inhabiting ants' nests, all go to show the value of taking up some special branch of study.

In the past it has been necessary to devote much time to the classification and naming of our insects, for without names we cannot record facts about them. An immense amount of work remains to be done in describing new species; I think, however, the time has come when more attention should be paid to field work, especially abroad. I could mention several monographs of families, and works dealing with the fauna of various countries in which there is scarcely a reference to the habits of a single species. This is difficult to avoid because the entomologists who write the systematic works are not themselves the collectors of the specimens. I feel sure, however, that one reason why so few observations on the habits of the species are appended to the description is, that their importance has not been appreciated.

The subject which I have brought before you is full of interest, and much careful field observation will be needed to clear up the points which I have raised. Here, then, are openings for many young enthusiasts, and if what I have said should induce any of you, or our friends abroad, to make some particular branch of this subject your special study I shall not have delivered this Address in vain.

GENERAL INDEX.

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Explanation of Plates I—III.

CORRECTION.

Owing to an unfortunate oversight, the numbers of these Plates have been transposed.

Plate	I	should be renumbered	II.
„	II	„ „	III.
„	III	„ „	I.

On Plate I (as amended), Figs. 25 and 26 should be renumbered 15 and 20.

Explanation of Plate I.

1. *Casyapa kallima*, Swinhoe, N. Guinea, p. 3.
2. *Tagiades utanus*, Plötz, Malacca, p. 4.
3. „ *titus*, Plötz, Philippines, p. 5.
4. „ *kowaia*, Plötz, N. Guinea, p. 5.
5. „ *louisa*, Swinhoe, Rossel Isl., p. 6.
6. *Celænorhinus chinensis*, Swinhoe, Omei-Shan, p. 8.
7. „ (*Tagiades*) *editus*, Plötz, Aru Isl., p. 9.
8. *Charmion* (*Plesioneura*) *queda*, Plötz, Malacca, p. 9.
9. *Abaratha siamica*, Swinhoe, Shan States, p. 10.
10. *Tagiades neira*, Plötz, Aru Isl., p. 4.
11. „ „ (lower figure), upperside.
12. „ „ „ underside.
13. *Antigonus philotimus*, Plötz, Aburi, p. 7.
    = *Sarangesa bouvieri*, Mab.
14. *Sarangesa haplopa*, Swinhoe, E. Ruwenzori, p. 7.
15. *Pyrgus nora*, Plötz, Angola, p. 10.
    = *Hesperia colotes*, Druce.
16. *Telesto maykora*, Plötz, Aru Isl., p. 10.
17. *Apaustus discreta*, Plötz, India, p. 12.
    = *Æromachus stigmata*, Moore.
18. *Arnetta binghami*, Swinhoe, Burma, p. 13.
19. *Zographetus* (*Apaustus*) *durga*, Plötz, Philippines, p. 13.
20. *Taractrocera* (*Hesperia*) *aliena*, Plötz, Java, p. 16.
21. „ (*Telesto*) *sangira*, Plötz, Celebes, p. 16.
22. *Hesperia ahrendti*, Plötz, Amboina, p. 18.
    = *Padraona sunias*, Felder.
23. *Kedestes* (*Cyclopides*) *paola*, Plötz, Angola, p. 16.
24. „ „ *brunneostriga*, Plötz, Pundo Ndongo, p. 17.

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INDO-MALAYAN AND AFRICAN HESPERIDÆ.

Explanation of Plate II.

1. ? *Notocrypta* (*Plesioneura*) *leucographa*, Plötz, India, p. 27.
2. *Isoteinon melania*, Plötz, Malacca, p. 28.
   = *Astictopterus jama*, Felder.
3. *Hasora* (*Ismene*) *chabrona*, Plötz, Malacca, p. 34.
4. „ *habroa*, Swinhoe, Celebes, p. 35.
5. „ *wortha*, Swinhoe, Java, p. 35.
6. „ *meala*, Swinhoe, Celebes, p. 35.
7. *Padraona* (*Hesperia*) *tropica*, Plötz, Java, p. 18.
8. „ „ *wamba*, Plötz, Aru Isl., p. 19.
9. *Telicota* (*Hesperia*) *aruana*, Plötz, Aru Isl., p. 19.
10. „ *ternatensis*, Swinhoe, Ternate, p. 20.
11. *Corone* (*Hesperia*) *chrysozona*, Plötz, Philippines, p. 20.
12. „ „ *dobboë*, Plötz, Aru Isl., p. 20.
13. *Apaustus dschilus*, Plötz, N. Guinea, p. 21.
    = *Ocybadistes marnas*, Felder.
14. *Ocybadistes* (*Hesperia*) *flavoguttata*, Plötz, Manilla, p. 21.
15. „ (*Apaustus*) *tanus*, Plötz, N. Guinea, p. 21.
16. ? *Baoris* (*Hesperia*) *sakara*, Plötz, N. Guinea, p. 22.
17. *Parnara* (*Hesperia*) *wambo*, Plötz, Africa, p. 25.
18. „ „ *dändeli*, Plötz, Batavia, p. 25.
19. *Hesperia ibara*, Plötz, Madagascar, p. 25.
    = *Parnara pontieri*, Boisd.
20. *Caltoris* (*Hesperia*) *nirwana*, Plötz, Java, p. 22.
21. „ *laraca*, Swinhoe, Woodlark Isl., p. 22.
22. *Taractrocera* (*Thymelicus*) *ziclea*, Plötz, p. 16.

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INDO-MALAYAN AND AFRICAN HESPERIDÆ.

Explanation of Plate III.

1. *Baoris* (*Hesperia*) *beraka*, Plötz, Celebes, p. 21.
2. *Hasora mimosa*, Swinhoe, Borneo, p. 34.
3. *Caltoris* (*Hesperia*) *jolanda*, Plötz, Java, p. 22.
4. *Ismene lusca*, Swinhoe, Maros, S. Celebes, p. 33.
5. *Burara* (*Ismene*) *radiosa*, ♂, Plötz, Celebes, p. 33.
6. „ „ „ ♀, „ „
7. *Hasora* (*Ismene*) *certhia*, ♂, Plötz, Philippines, p. 33.
8. „ „ „ ♀, „ „
9. *Plesioneura wokana*, Plötz, Aru Isl., p. 27.
   = *Notocrypta insulata*, Butler.
10. *Notocrypta* (*Plesioneura*) *waigensis*, Plötz, Waigiou, p. 26.
11. „ *aluensis*, Swinhoe, Alu Isl., p. 27.
12. *Hasora* (*Ismene*) *lizetta*, Plötz, Java, p. 35.

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INDO-MALAYAN AND AFRICAN HESPERIDÆ.

Explanation of Plate IV.

Chrysocoris stollii (Wolff).

Fig. 1. Ovum on the first day, natural size and enlarged, viewed from on top and at the side.

1*a*. The same, looking on top, the third day.

2. Nymph just hatched.

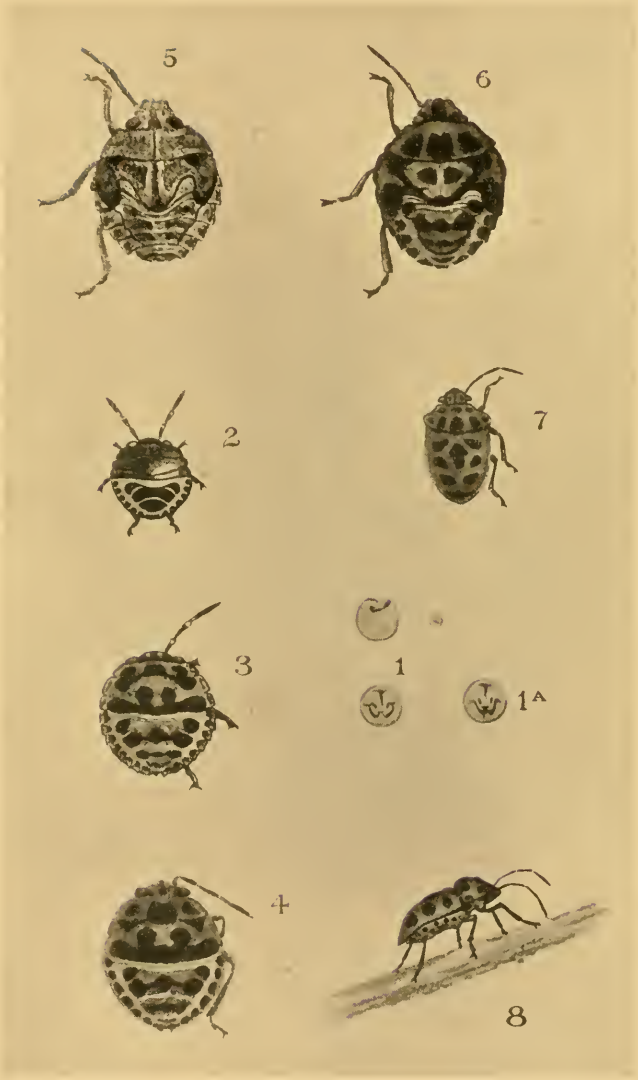
3. Second instar.

4. Third instar ; after this the bug remains much the same in colour and pattern.

5. Penultimate (?) instar of an allied species.

6. Penultimate instar.

7 and 8. Adult.



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CHRYSOCORIS STOLLII, Wolff.

Explanation of Plate V.

Riptortus linearis (Linné).

Fig. 1. Ova, natural size and enlarged.
2. Third nymphal instar, enlarged.
3. The same, natural size.
4. Ultimate nymphal instar, twice natural size.
5. Adult, natural size.
6. First nymphal instar, much enlarged.

Food-plant: *Cassia occidentalis*, Linné, N. O. *Leguminosæ*.

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RIPTORTUS LINEARIS, Linné.

Explanation of Plate VI.

Fig. 1. Larva of *Trictenotoma childreni*, Gray.

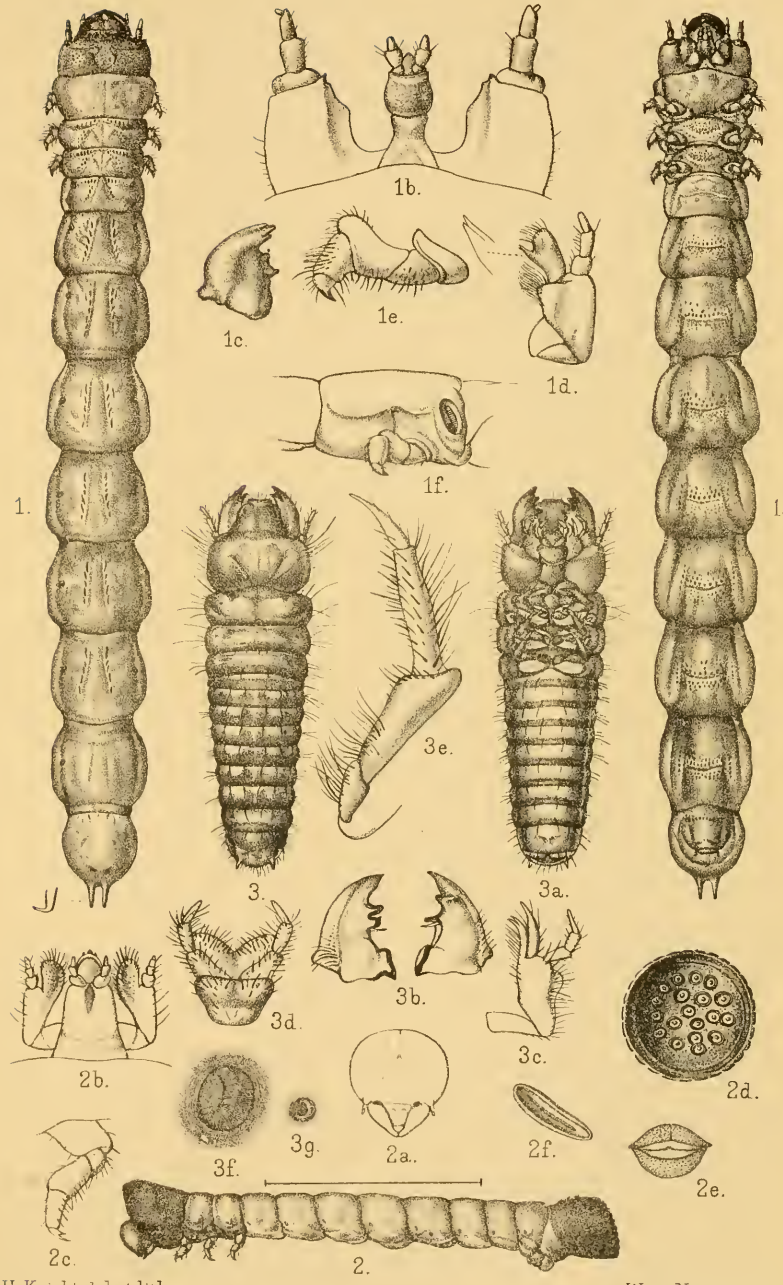
1*a*. Ventral side. 1*b*. Under-side of head with maxillæ removed. 1*c*. Mandible. 1*d*. Maxilla. 1*e*. Leg. 1*f*. Prothorax from side, showing spiracle.

2. Larva of *Melittomma insulare*, Fairm.

2*a*. Head, front view. 2*b*. Labium and Maxillæ. 2*c*. Leg. 2*d*. Posterior concave face of 9th abdominal segment. 2*e*. 10th segment, forming pseudopod, and inclosing anus. 2*f*. Mesothoracic spiracle.

3. Larva of *Dascillus cervinus*, L.

3*a*. Ventral side. 3*b*. Mandibles. 3*c*. Maxilla. 3*d*. Labium. 3*e*. Leg. 3*f*. Prothoracic spiracle. 3*g*. Spiracle of 3rd abdominal segment.



H. Knight del. et lith.

West, Newman imp.

LARVÆ OF COLEOPTERA.

Explanation of Plate VII.

N.B.—The figures do not illustrate the many points touched on in the paper, but are intended to show one or two of the more striking characters common to the Dolichopodidæ, Phoridæ, Lonchopteridæ and Leptidæ, and the absence of affinity to the Muscidæ.

Fig. 1. Antenna of *Conicera atra*, Mg. ♂. Diagram in optical section, as seen with a magnification of 300 diameters (all the figures of antennæ are drawn in a similar manner, their size being regulated by convenience for comparison). To show the peculiar articulation of the third joint; I would also draw attention to the bristle-sockets on the distal joint of the arista. The antennæ of the female differ in shape, but are articulated in the same way.

Fig. 2. Antenna of *Phora ruficornis*, Mg., to show the same points as in Fig. 1. The sexes do not differ in the shape of the antennæ.

Fig. 3. Antenna of *Lonchoptera flavicauda*, Mg., to show the similarity of articulation to that found in the Phoridæ and *Dolichopus*. The bristle-sockets on the arista are also similar.

Fig. 4. Antenna of *Dolichopus acuticornis*, W. (?). In addition to the peculiar articulation, this species has a process, possibly the remains of a joint, between the second and third joints, exactly similar to that found in *C. atra*. The bristle-sockets on the arista are absent.

Fig. 5. Antenna of *Scatophaga lutaria*, F. To show the usual method of articulation in the Muscidæ (invariable as far as my observations go, even such long third joints as are found in Loxocera, retaining it). A third method of articulation is visible to the ordinary lens, and calls for no remark, except that it is dissimilar to those figured.

Fig. 6. Antenna of *Gymnopternus assimilis*, Staeg. To show a similar articulation to the other four species.

Fig. 7. One of the labella (paraglossæ) from the mouth parts of *L. flavicauda*, to show the arrangement of the tracheæ, the plate from which they spring and the large number of sensory hairs on the edge. Actual size of the part, length $\frac{17}{10}$ mm. or $\frac{1}{100}$ inch.

Fig. 8. One of the labella of *Leptis conspicua*, Mg., for comparison with *L. flavicauda* and *Phora concinna*, Mg. ♂. The tracheæ spring from a plate, the arrangement is similar, and there are a great

number of sensory hairs on the edge. The under-sides of the labella are partly chitinised, and similar conditions exist in *P. concinna*; it is indicated on both figures by the darker shading.

The rod at the base is one of the mandibles which are in this species separate, but embedded on the ventral side. The mentum is but little developed, but in the Leptid genus *Chrysopilus* it will be found in a condition very similar to those figured as 11, 12, 15, with the median suture and the cleft process at the anterior end Length $1\frac{3}{10}$ mm. or $\frac{1}{21}$ inch.

Fig. 9. One of the labella of *Phora concinna*, Mg. ♂, to show the tracheæ springing from a plate, and the great number of "taste hairs" on the edge. The triangular process at the side is the aculeation characteristic of the Phorid trophi. It consists of the laciniæ of the maxillæ fused at their points. In *Gymnophora arcuata*, Mg. and *P. curvinervis*, Beck. (♀ only) the stipites and cardines are also visible at this part of the mouth. Length $\frac{2}{7}\frac{3}{0}$ mm. or $\frac{1}{77}$ inch.

Fig. 10. The labial palpus of *P. concinna*. To show the two joints, a Nematocerous character never found in the Muscidæ. Length $\frac{2}{7}$ mm. or $\frac{1}{90}$ inch.

Fig. 11. Mentum of *L. flavicauda*, dissected out from the mouth and viewed from the ventral side, the anterior portion being uppermost. To show the median suture of the part, absent in the Muscidæ. (Compare Fig. 13.)

The bristles are also of interest, being exactly similarly placed in *P. curvinervis*, Beck. ♂. (Compare with Fig. 15.) Length $\frac{1}{7}$ mm. or $\frac{1}{180}$ inch.

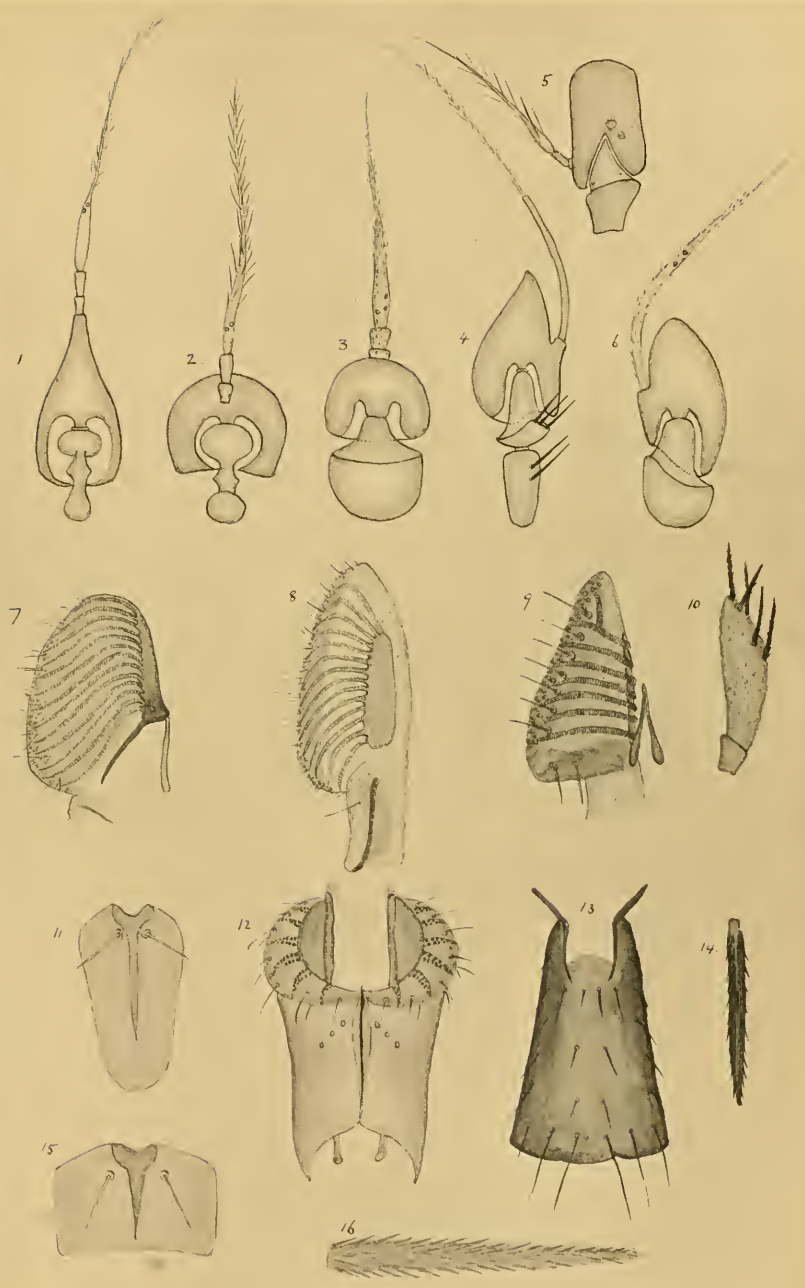
Fig. 12. Labium of *Dolichopus griseipennis*, Stan. Ventral side, to show the mentum, with the median process and the bristle-holes. (Compare with Figs. 11 and 15.) Breadth, circa $\frac{2}{7}$ mm. or $\frac{1}{90}$ inch.

Fig. 13. Mentum of *Musca corvina*, F. Shown in the same position as the other figures of this part. On comparison with them it will be seen that the median suture is wanting; this condition is always found in the Muscidæ. Length at longest part $\frac{9}{14}$ mm. or $\frac{1}{40}$ inch.

Fig. 14. The characteristic Phorid bristle; for comparison with Fig. 16. Taken from the middle tibia of *P. incrassata*, Mg. ♀. Length $\frac{6}{30}$ mm. or $\frac{1}{150}$ inch.

Fig. 15. Mentum of *P. curvinervis*, Beck., for comparison with the part in other families. The sides are much developed and flap over; this is indicated in the drawing. Length $\frac{9}{70}$ mm. or $\frac{1}{260}$ inch.

Fig. 16. Mycetophilid bristle, one of two on the apex of the hind tibia of *Sciara thomæ*, L. This structure is found only on the legs of the Mycetophilidæ. Length $\frac{5}{10}$ mm. or $\frac{1}{90}$ inch.



W. Wesché del. ad nat.

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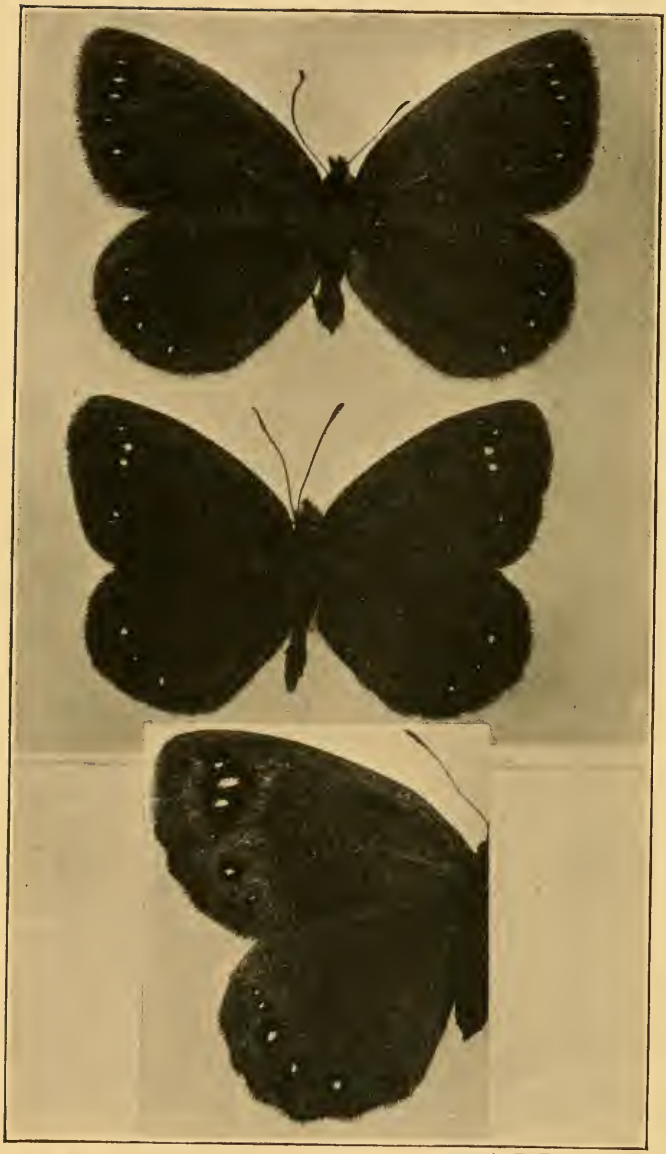
AFFINITIES OF THE PHORIDÆ.

Explanation of Plate VIII.

Photographs (by A. E. Tonge, Esq.) of upper surfaces of

1. *Erebia lefebvrei*, ♂ (3-spotted form).
2. „ *melas*, ♂ „
3. „ *nerine*, ♀ „ *i. e.* ordinary form) × $\frac{12}{17}$.

The figures show how *melas* and *nerine* agree in the position of the ocelli on the fore-wing, and how much they differ from *lefebvrei*, in which the apical ocelli are not only in line, but all are much nearer the hind margin, this being greatest with the 2nd (usually 1st) ocellus.



1

2

3

A. E. Tonge, Phot.

Erebia: (1) lefebvrei ♂, (2) melas ♂, (3) nerine ♀ × 1·7.

Explanation of Plate IX.

Photographs (by A. E. Tonge, Esq.) of under-sides of

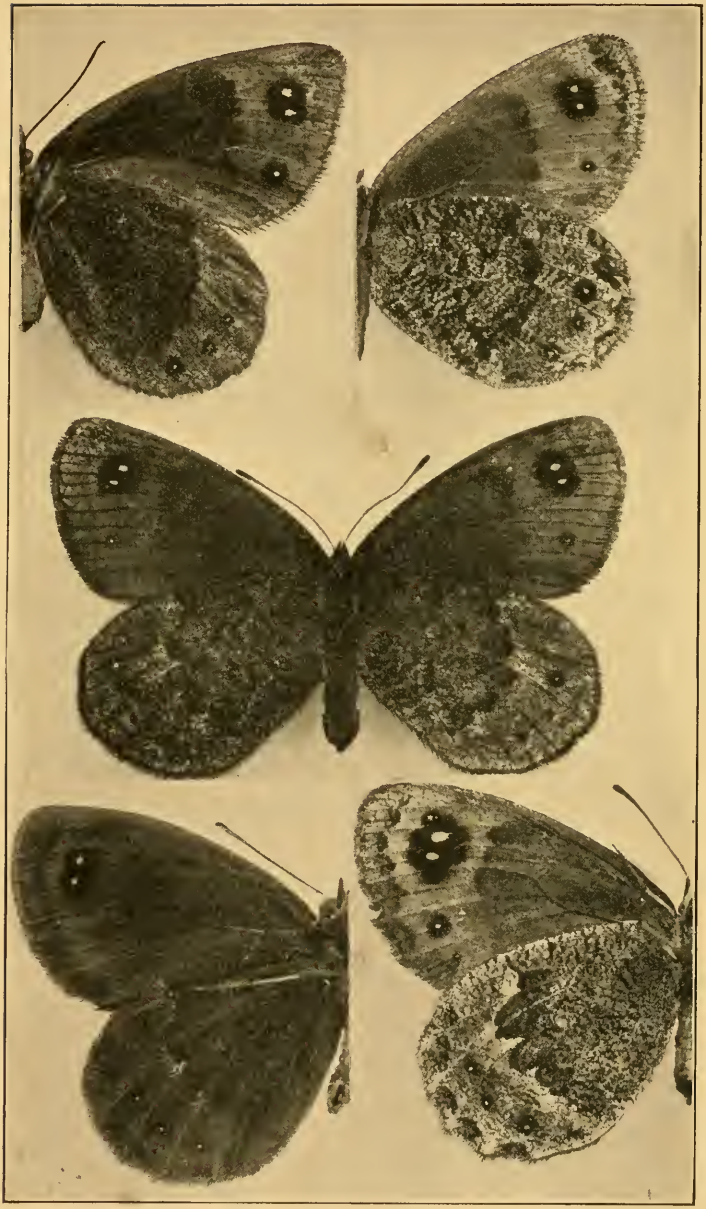
1. *Erebia lefebvrei*, ♀, showing the comparative straightness of the outer margin of inner dark area of hind-wing, and how it approaches the hind margin at the lowest ocellus.

2 and 3. *Erebia melas*, ♀ ♀. 2 shows how the general tone differs from that of *lefebvrei*, and agrees with that of *nerine*. And 3 how the outer margin of the inner dark area is very much the same as in *nerine* (Fig. 4 and 5) in outline.

4. *Erebia nerine*, ♂.

5. „ *nerine*, ♀.

In 2, 3, 4 and 5 the line in question is remote from the lowest ocellus and passes on to the inner margin. All × $\frac{1}{7}^{2}$.



A. E. Tonge, Phot.

Undersides of Erebia: (1) lefebvrei ♀, (2, 3) melas ♀, (4) nerine ♂, (5) nerine ♀ × 1·7.

Explanation of Plate X.

Photographs (by A. E. Tonge, Esq.) of under-sides of

1. *Erebia lefebvrei*, ♂.
2. ,, *melas*, ♂. × $\frac{12}{7}$.

They show, as Plates VIII and IX, that the apical ocelli are much nearer the hind margin in *lefebvrei* than in *melas*, and that in the former the pale band on the hind-wing can just be made out, in the latter much more distinct.

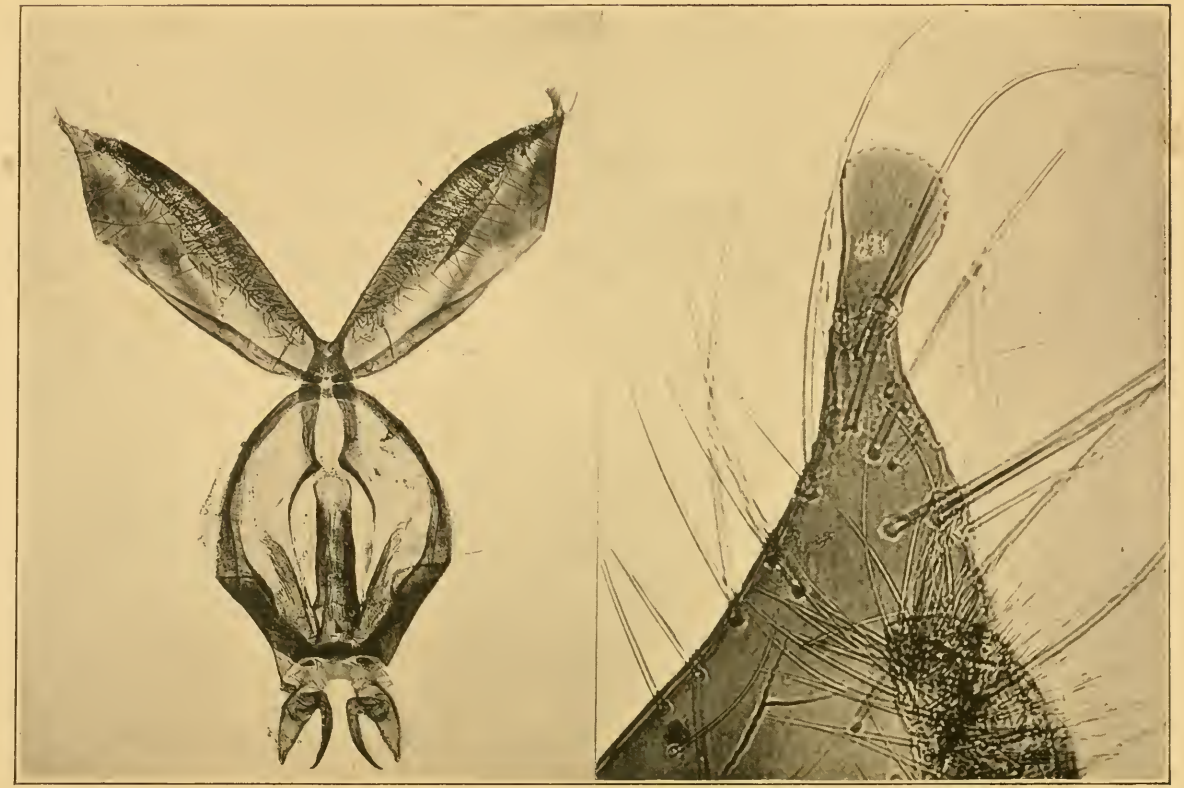
A. E. Tonge, Phot.

Undersides of Erebia: (1) lefebvrei ♂, (2) melas ♂ × 1·7.

Explanation of Plate XI.

Fig. 1. Ancillary appendages of *Lycæna pyrenaica* × 25.
2. Extremity of clasp × 180.

1



2

F. N. Clark, Phot.

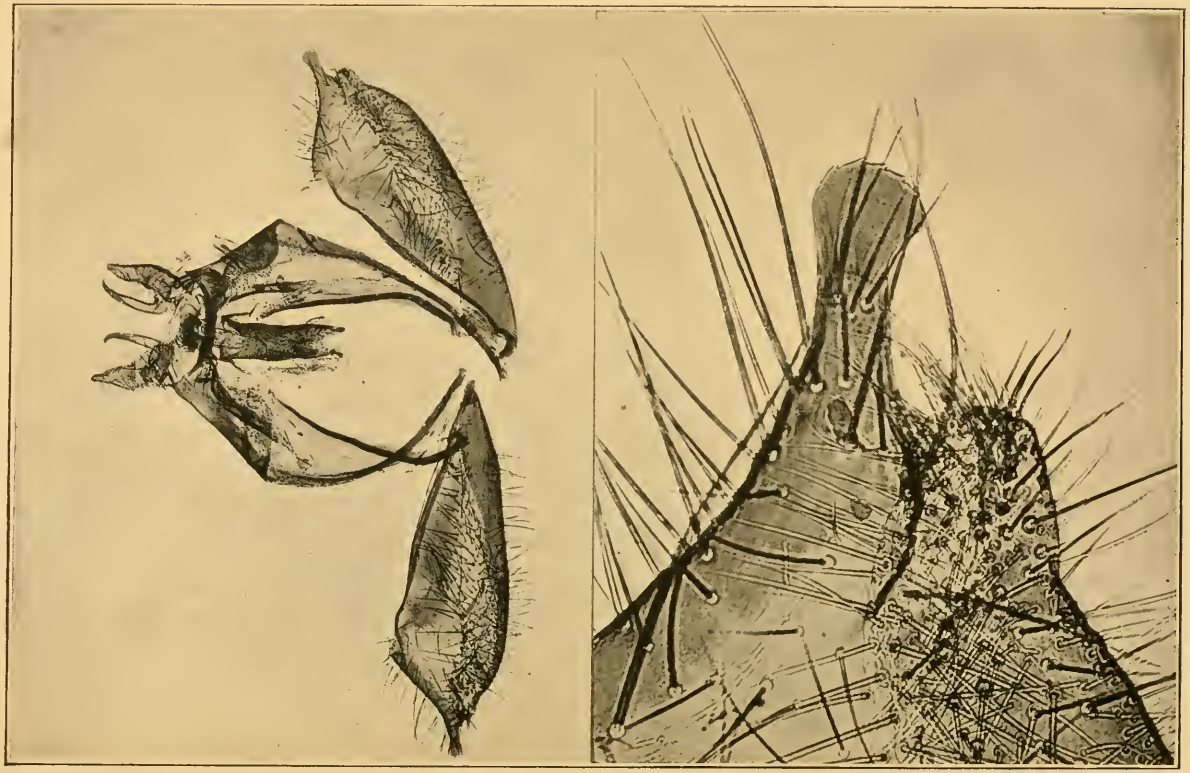
(1) Ancillary Appendages of Lycæna pyrenaica × 25.

(2) Extremity of clasp × 180.

Explanation of Plate XII.

Fig. 1. Ancillary appendages of *Lyc. orbitulus* (Arolla) × 25.
2. Extremity of clasp × 180.

1



2

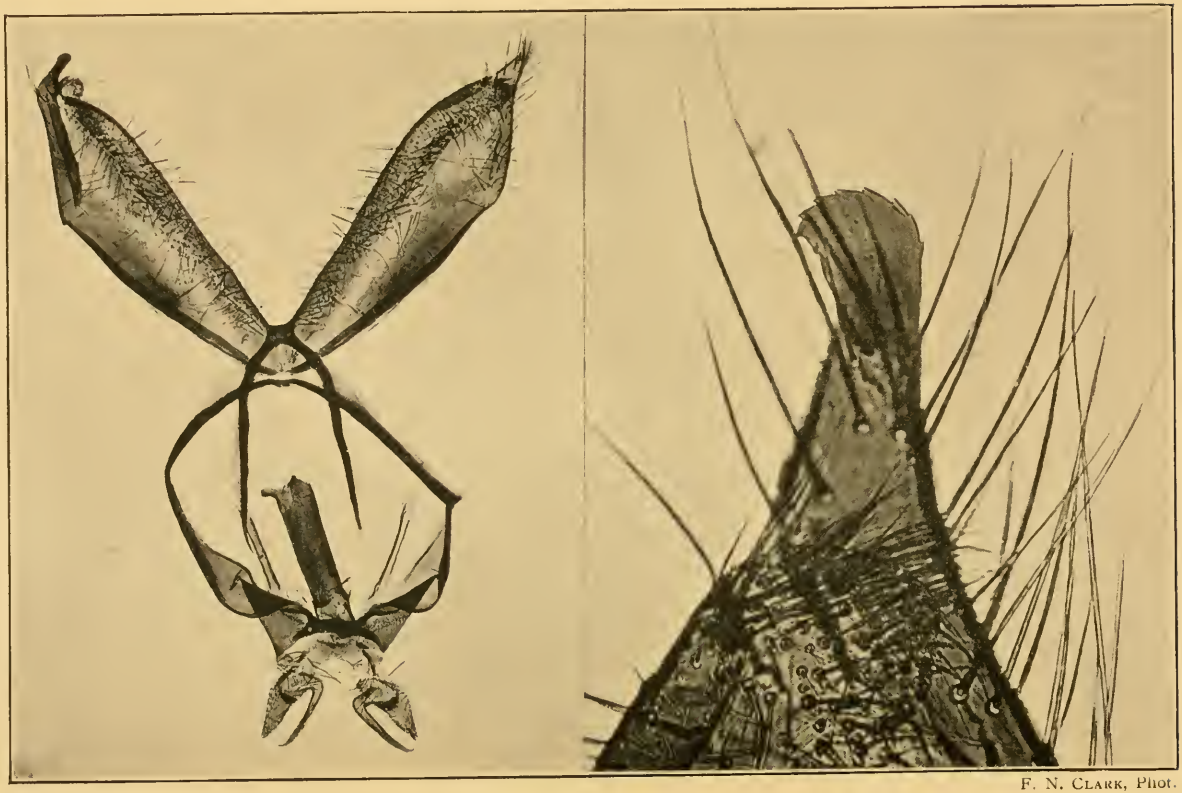
F. N. Clark, Phot.

(1) Ancillary Appendages of Lyc. orbitulus (Arolla) × 25.

Explanation of Plate XIII.

Fig. 1. Ancillary appendages of *Lyc. orbitulus*, var. *oberthüri* (Lac de Gaube) × 25.

2. Extremity of clasp × 180.



F. N. Clark, Phot.

(1) Ancillary Appendages of *Lyc.-orbitulus*, var. *oberthuri* (Lac de Gaube) × 25.

(2) Extremity of clasp × 180

Explanation of Plate XIV.

Fig. 1. *Stenoptilia grandis*, ♂, real size.
2. ,, ,, ♀, ,,
3. ,, probably *grandis*, ♂, real size, from Pajares.
4. End of fore-wing of *S. grandis* × 3 diameters.
5 and 7. ,, ,, *S. coprodactylus* × 4 diameters.
6. ,, ,, *S. pneumonanthes* × 4 diameters.

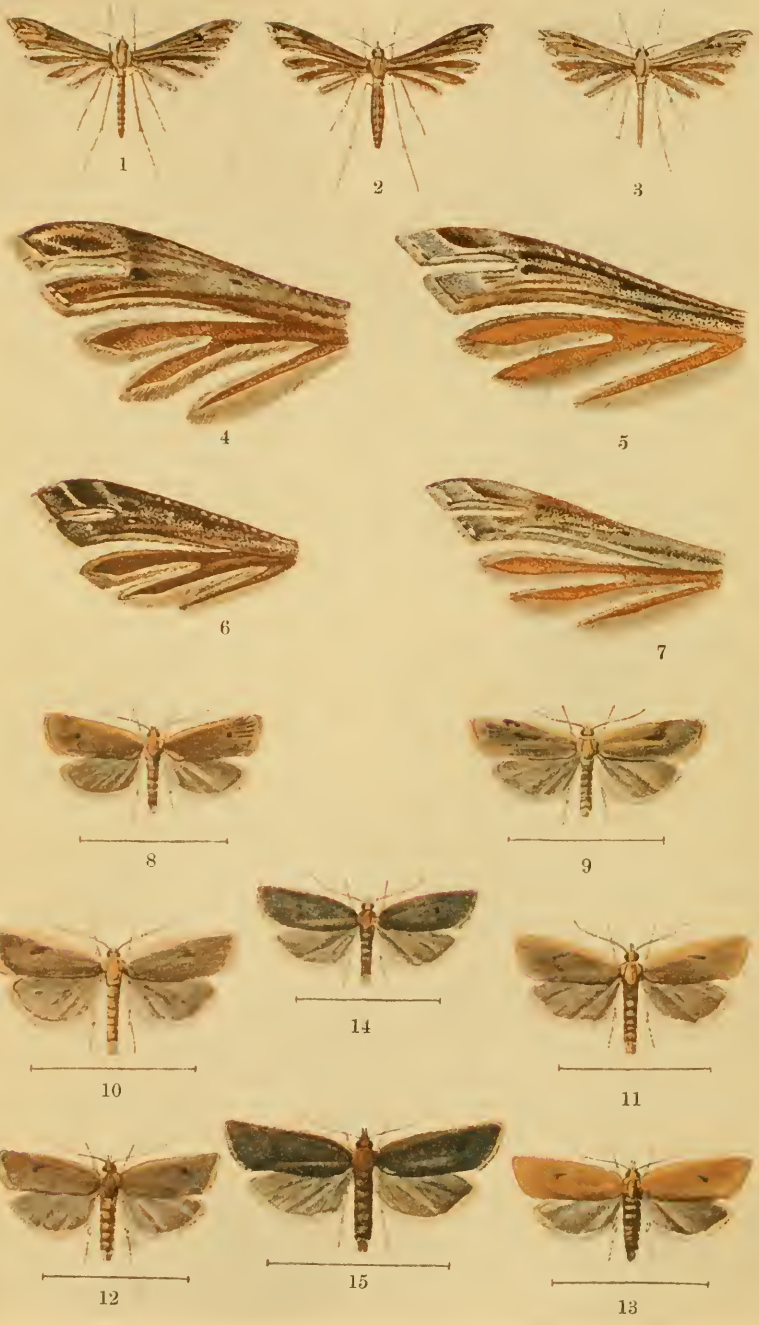
Note, to make them look same size on the plate, the artist has magnified *grandis* only three times, the others four; unfortunately this obscures the great difference in size.

The figure 6 rather exaggerates the squareness of the end of the plume in *pneumonanthes*, which in truth hardly affects the outline of the wing but refers to the pale cross line. It illustrates how, when you tell an artist what you see, he often sees it more distinctly and clearly than you do, and it is by no means always the artist who is wrong.

8–13. Dark forms of *H. hyerana-hyerana*.
14–15. ,, ,, ,, ,, *marginata*.

These are the darkest hitherto bred and are some of those mentioned in Proc. Ent. Soc., 1907, p. ii.

Compare these with figures of ordinary forms figured in E. M. M., Vol. 42, 1906, Pl. 3, and Trans. Ent. Soc. Lond. 1906, Pl. VIII.



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STENOPTILIA GRANDIS AND HASTULA HYERANA.

Explanation of Plate XV.

Diagrams (from camera sketches) of tegumina of certain *Stenoptilias* × 80.

Fig. 1. *Fuscus.*
2. *Bipunctidactylus.*
3. *Zophodactylus.*
4 and 5. *Coprodactylus.*
6. *Graphodactylus (pneumonanthes).*
7. *Grandis.*

The terminal lobes of *coprodactylus* have a variable, irregular membrane extending beyond the scaled portion.

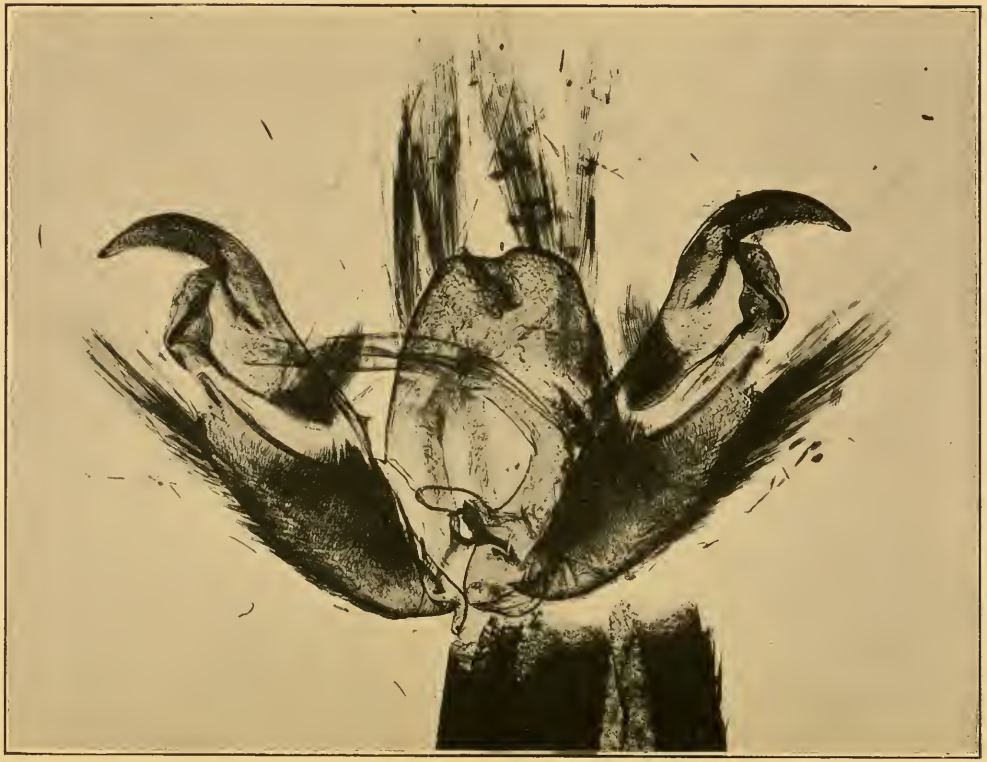
Graphodactylus (*pneumonanthes*) has the terminal lobes rounded with well-marked sulcus. *Grandis* resembles it closely in this respect.

The uncus also is much alike in these two species, being thick tapering regularly, the basal half with complicated fold and with sensory hairs nearly throughout, contrasting with *coprodactylus*, in which the uncus is more slender, with widened conical base, and hardly any sensory hairs on the slender terminal portion.

Diagrams of dorsal portions (tegumen) of Ancillary Appendages of Stenoptilias, × 80.

Explanation of Plate XVI.

Ancillary appendages of *Stenoptilia grandis* × 45.



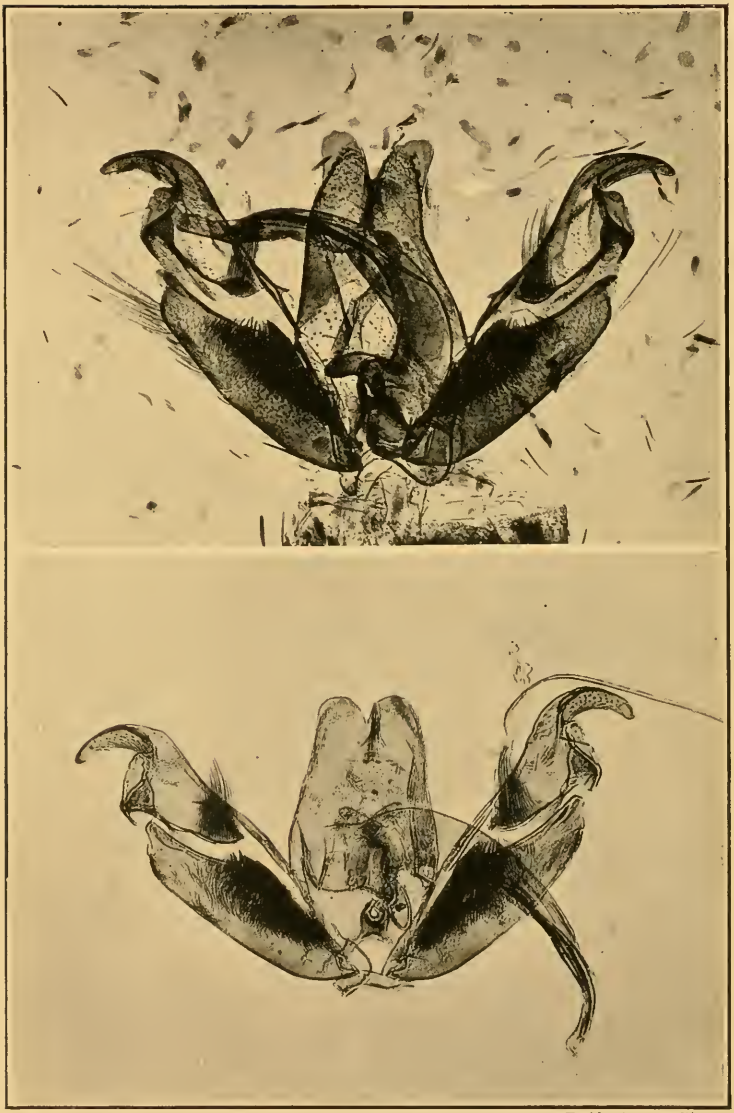
F. N. Clark, Phot.

Ancillary Appendages of S. grandis, × 45.

Explanation of Plate XVII.

Ancillary appendages of

Fig. 1. *Stenoptilia coprodactylus* × 45.
2. „ *graphodactylus* × 45.



1

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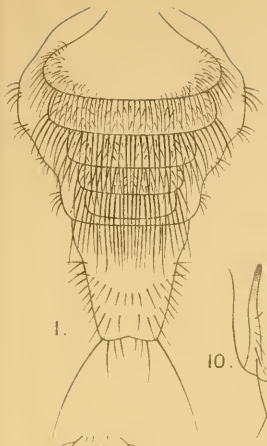
F. N. Clark, Phot.

Ancillary Appendages of (1) S. coprodactylus and (2) S. graphodactylus × 45.

Explanation of Plate XVIII.

Fig. 1. *Penicillidia jenynsi*, ♂, dorsal view of abdomen.
2. „ „ „ ventral view of abdomen.
3. *P. jenynsi*, ♀, abdomen dorsal.
4. „ „ abdomen ventral.
5. „ „ apical part of plate before the genital opening, enlarged.
6. *P. jenynsi*, larva, dorsal view.
7. „ lateral view of anterior constricted part.
8. „ front „ „ „ „
9. *Nycteribia insolita*, ♂, abdomen dorsal.
10. „ „ „ ventral view of anal segment.
11. *N. insolita*, ♀, abdomen dorsal.
12. „ „ thorax and abdomen, ventral.
13. „ „ front aspect of middle femur and tibia.
14. *Nycteribia sauteri*, ♂, front aspect of middle femur and tibia.
15. *Nycteribia sauteri*, ♂, abdomen dorsal.
16. „ „ „ „ ventral.
17. *N. sauteri*, ♀, abdomen dorsal.
18. „ „ thorax and abdomen, ventral.
19. *Cyclopodia roylei*, ♂, abdomen dorsal (smaller scale).

The figures were all made with the help of a drawing-apparatus. Figs. 16 and 18 (the ventral aspects of the abdomen) appear shorter than the corresponding dorsal aspect (Figs. 15 and 17) owing to curvature of the abdomen.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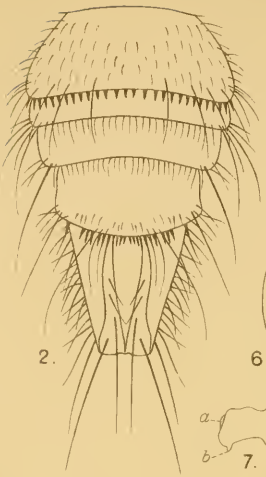
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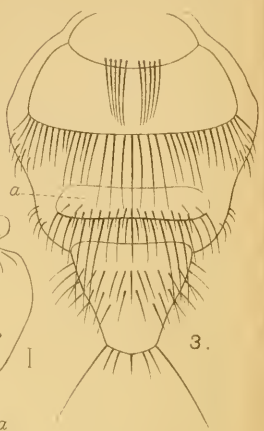

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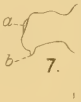

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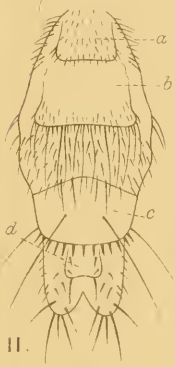

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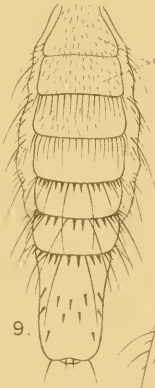

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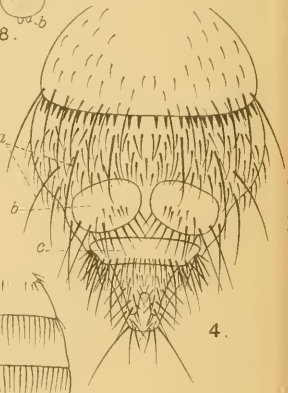

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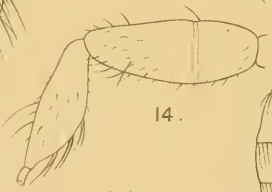
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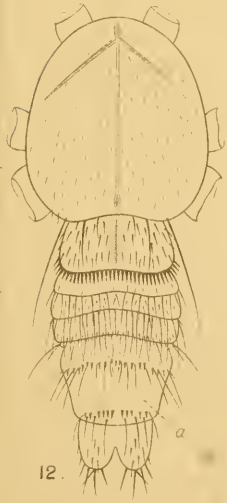

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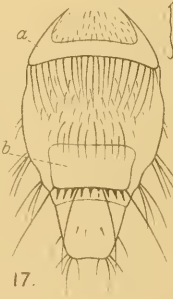

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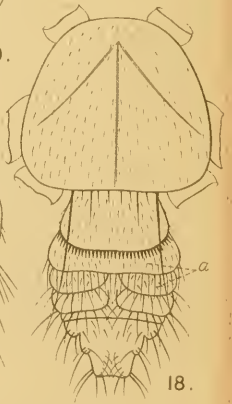


18.

H. Scott, del.

E. Wilson, Cambridge.

DETAILS OF NYCTERIBIIDAE.

Explanation of Plates XIX, XX.

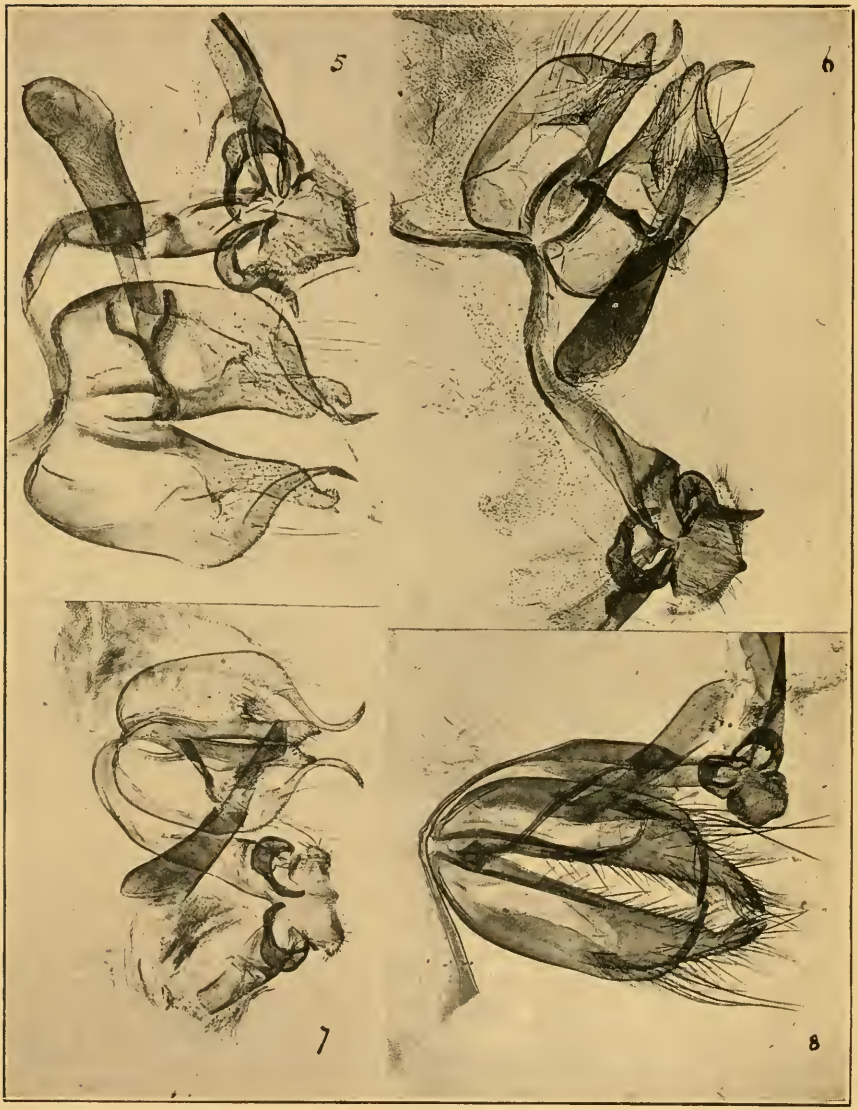
Ancillary appendages of males of Everes.

Plate XIX, Fig. 1.	*Argiades*	(Guethary)	× 34.
2.	,,	(Vernet-les-Bains)	× 38.
3.	*Coretas*	(,, „ ,,)	—
4.	,,	(Hungary)	—
Plate XX, Fig. 5.	*Amyntula* (?)	(California)	—
6.	,, (?)	(Calgary)	—
7.	,, (??)	(Costa Rica)	—
8.	*Parrhasius*		

The specimens are prepared by cutting through one side of the ring forming 9th abdominal segment and opening out flat as nearly as may be. The tegumen cannot be divided in the median line without practically destroying it, a proceeding that is best in *Cyaniris*, and practically in *Lycæna*.

F. N. Clark, Phot.

Everes argiades and E. coretas.



F. N. Clark, Phot.

Everes amyntula and E. parrhasius.

Explanation of Plate XXI.

1. *Pyrrhopyge infantilis*, sp. n. ♂.
2. „ *cruor*, „ ♂.
3. „ *sanies*, „ ♂.
4. *Jemadia scomber*, „ ♀.
5. *Thymele palliolum*, „ ♀.
6. *Prenes grapte*, „ ♂.
7. *Aides incantator*, „ ♀.
8. *Dion gemmatus*, Butler, sp. n. ♀.
9. „ *rubrinota*, „ ♂.
10. *Thracides panimeron*, „ ♂.
11. *Pyrrhopygopsis lugubris*, „ ♂.
12. „ *agaricon*, „ ♂.

Horace Knight del.

Andre & Sleigh, Ltd.

NEW HESPERIIDÆ FROM CENTRAL AND SOUTH AMERICA.

Explanation of Plate XXII.

Fig. 1. *Lophotettix brevicristatus*, gen. et sp. nov.
(*a*) Side view of body; (*b*) one of the antennæ and head viewed from above.

2. *Holoarcus altinotus*, gen. et sp. nov.
Side view of body.

3. *Oxyphyllum pennatum*, gen. et sp. nov.
Side view of body.

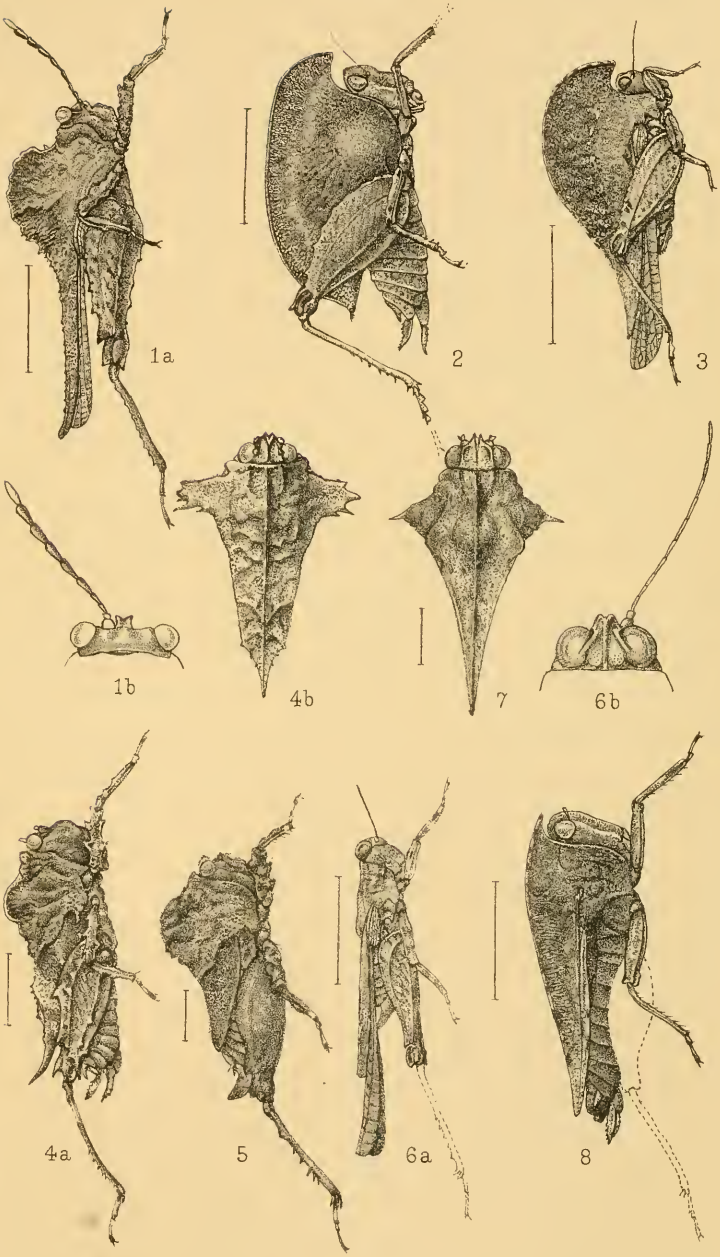
4. *Tettilobus spinifrons*, gen. et sp. nov.
(*a*) Side view of body; (*b*) dorsal view showing the lateral lobe of pronotum with the posterior angle.

5. *Gignotettix burri*, gen. et sp. nov.
Side view of body.

6. *Orthotettix obliquifrons*, gen. et sp. nov.
(*a*) Side view of body; (*b*) head showing vertex viewed from above.

7. *Thoradonta spinata*, gen. et sp. nov.
Viewed from above, showing head and lateral lobes of pronotum.

8. *Halmatettix cristinotus*, gen. et sp. nov.
Side view of body (hind femora missing in type).



H. Knight del. et lith.

West, Newman imp.

NEW SPECIES OF TETRIGINÆ.

Explanation of Plate XXIII.

Examples of the various mimetic forms of *Papilio dardanus*, subsp. *cenca*, bred by Mr. G. F. Leigh in 1906 from a *hippocoon* form of female, captured Aug. 3, 1906, near Durban, Natal. The figures represent four of the female offspring out of the family of 16 males and 16 females bred by Mr. Leigh. The female parent and the Danaine models are also represented. The specimens are in the Hope Department, Oxford University Museum.

All the figures are about $\frac{5}{8}$ of the natural size.

Figs.

1. The female parent (*hippocoon*, ♀ f. of *P. dardanus*, subsp. *cenea*): captured Aug. 3, 1906, and laid 32 eggs Aug. 4-6, which hatched Aug. 10-12.

2a. One of the three *hippocoon* offspring bred from the above. The larva pupated Sept. 24, and the imago emerged Oct. 15.

2. Danaine model of the above from the same locality, viz. *Amauris niavius*, subsp. *dominicanus*. The specimen, a female, was captured by Mr. Guy A. K. Marshall at Durban, April 4th, 1896.

3a. One of the three *trophonius* offspring bred from the *hippocoon* parent (Fig. 1). The larva pupated Sept. 21, and the imago emerged Oct. 7.

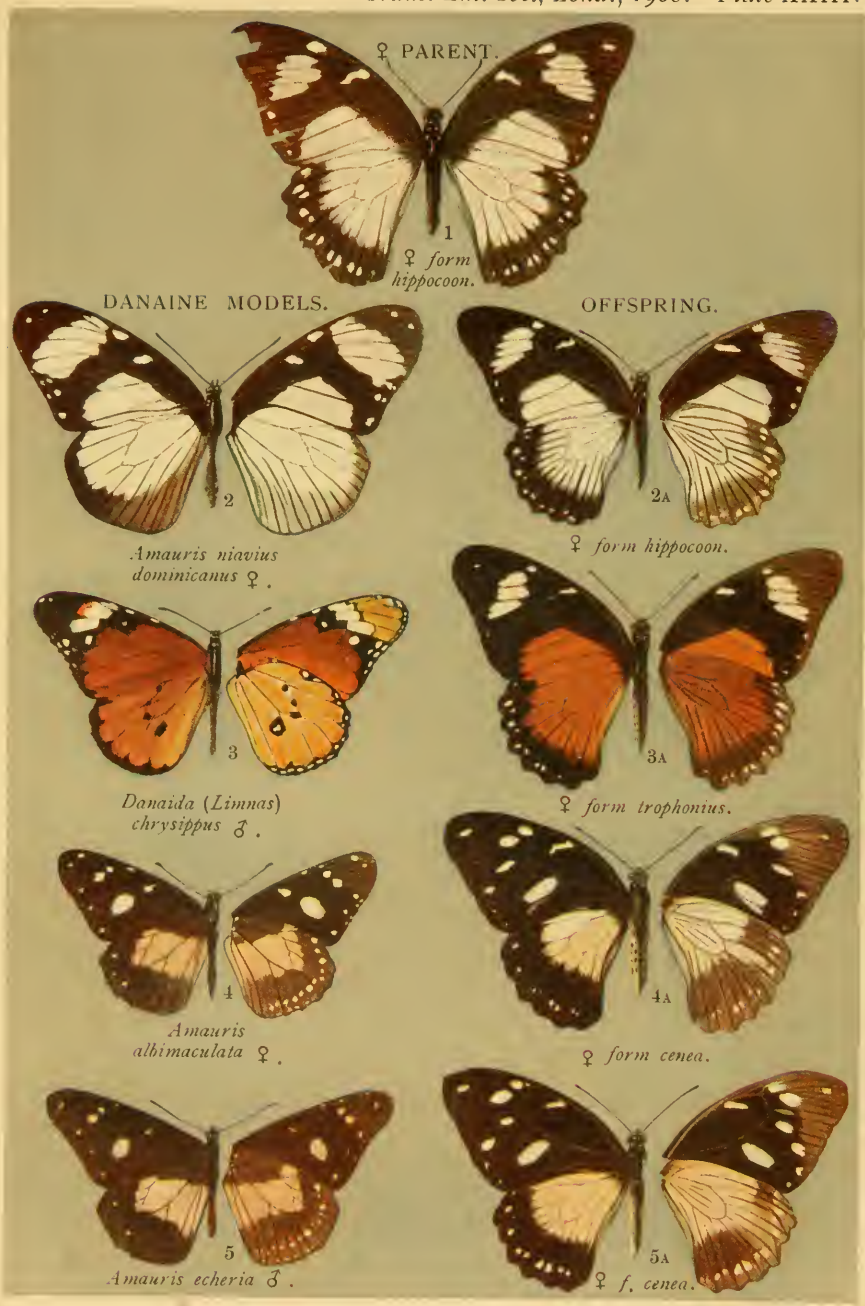
3. Danaine model of the above from the same locality, viz. *Danaida* (*Limnas*) *chrysippus*. The specimen, a male, was captured by Mr. Marshall at Malvern, near Durban, Aug. 15, 1896.

4a. One of the three *cenea* offspring with all the spots in the fore-wing white, bred from the *hippocoon* parent (Fig. 1). The larva pupated Sept. 14, and the imago emerged Sept. 30.

4. Danaine model of the above from the same locality, viz. *Amauris albimaculata*. The specimen, a female, was captured by Mr. Marshall at Malvern, near Durban, Aug. 12, 1896.

5a. One of the five *cenea* offspring with the chief spot of the fore-wing pale ochreous, bred from the *hippocoon* parent (Fig. 1). The date of pupation unnoted. The imago emerged Oct. 24.

5. Danaine model of the above (as regards the ochreous tint of the chief spot), from the same locality, viz. *Amauris echeria*. The specimen, a male, was captured by Mr. Marshall at Malvern, near Durban, Aug. 11, 1896.



Mrs. P. P. Whelpley, pnx. André & Sleigh, Ltd.

All figures are about ⅔ of the natural size.

Examples of the mimetic female forms of *Papilio dardanus*, subsp. *cenea*, bred in 1906 from a *hippocoon* form of female: Durban, Natal. The female parent and the Danaine models from the same locality are also figured.

Explanation of Plate XXIV.

The female parent (*cenea* female form of *Papilio dardanus*, subsp. *cenea*) together with one-third of the males and the whole of the female offspring (except one greatly deformed *cenea*) bred from it by Mr. G. F. Leigh, at Durban.

All the figures are about $\frac{2}{3}$ of the natural size.

Figs.

1. The female parent, captured Jan. 14, 1907, and laid 42 eggs Jan. 15 and 16. The spots (1)-(4) round the end of the fore-wing cell are well developed. The chief spot is pale ochreous, the others white. The spot (5) in the cell is divided into two. The hereditary transmission of these and other characters of the parent described on p. 438, may be traced in the *cenea* offspring Figs. 7–21.

The male offspring are shown in Figs. 2–6.

2. The example in which the submarginal black band of the hind-wing is least developed.
3. The example which follows Fig. 2 when the specimens are arranged in the order of the increasing heaviness of the black band.
4. After Fig. 3 succeed two unfigured specimens and then the example here represented.
5. An unfigured example follows Fig. 4, and then the specimen here shown, which is succeeded by seven unfigured males.
6. The seven specimens above referred to are followed by the male here represented,—the individual in which the band is blackest

The female offspring of the *cenea* form are shown in Figs. 7–21. These are fully described in the order of the figures on pages 440, 441.

7—13. The specimens shown in these seven figures possess the normal number of spots (1)–(4) in the fore-wing, resembling the parent in this respect, although in some of them the spots are smaller. The fore-wing spots in the specimen shown in Fig. 9 are more ochreous than in any other, the remaining 14 *cenea* offspring being in this respect nearly in the condition of the parent.

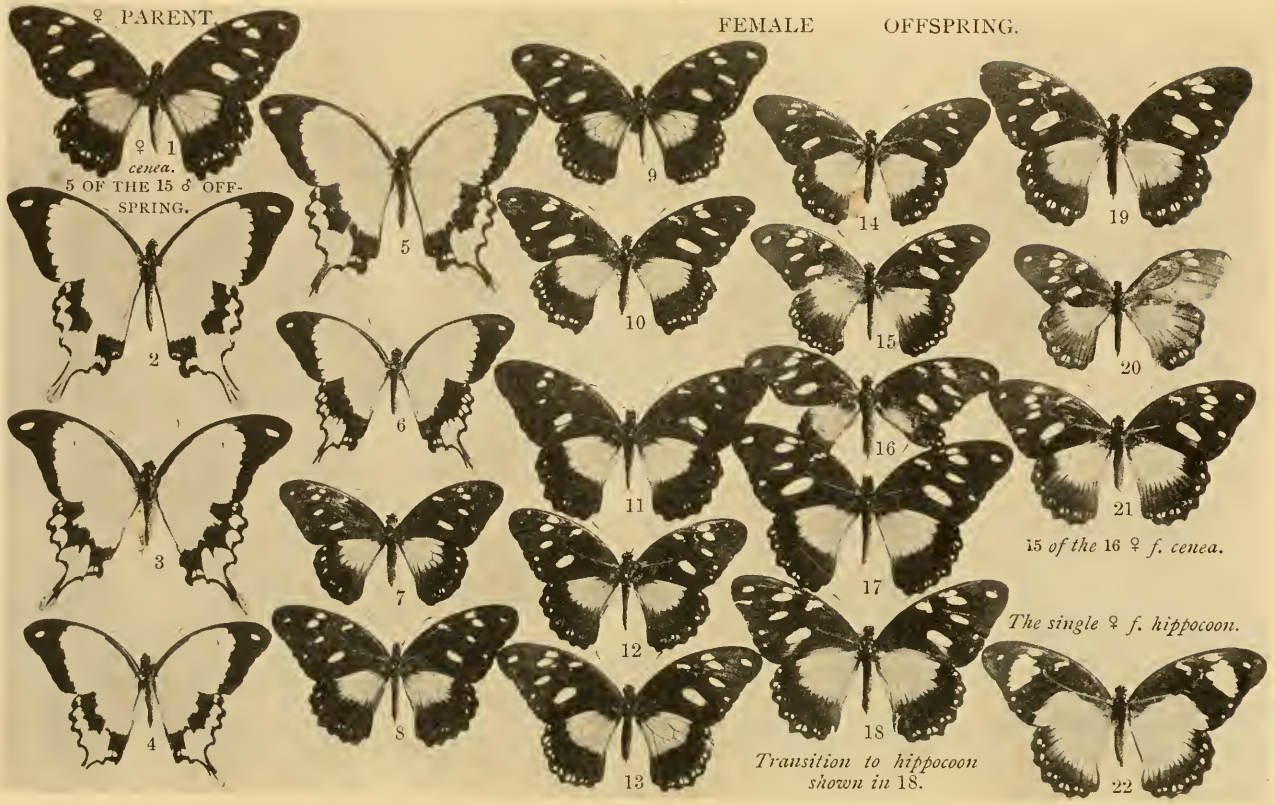
Explanation of Plate XXIV.

FIGS.

14—19. These specimens have an additional fore-wing spot (4*a*) beyond (4) and over the end of the cell. The normal spots (1)–(4) are fully developed in all except the example represented in Fig. 14. Fig. 18 shows a rather marked transition towards the *hippocoon* pattern, in the pale linear patch on the inner margin of the fore-wing and the extension downwards and outwards of the chief spot (1) in the same wing.

20, 21. These females have another additional fore-wing spot (2*a*), between (2) and (3).

22. The single *hippocoon* female form in this family. Spot (5) within the fore-wing cell is seen to be divided, as in the parent. A similar division of (5) is seen in many of the *cenea* offspring as described on pp. 440, 441.



Alfred Robinson, phot.

All figures are about ⅔ of the natural size.

Witherby & Co.

The females (except one) and a third of the males bred in 1907 from a *cenea* female f. of *Pap. dardanus cenea*, Durban, Natal.

Explanation of Plate XXV.

Examples of *Limenitis* (*Najas*) *lorquini* and of *Limenitis* (*Adelpha*) *californica* (N.) and *bredowi* (S.), from various localities in their north-and-south ranges. The figures show the resemblances which are evident at the overlap, but diminish in *lorquini* to the N. and in *bredowi* to the S.

All the specimens figured are males. The originals of Figs. 2–9 are in the Godman-Salvin Collection in the British Museum of Natural History; of Figs. 1 and 10 in that part of the Godman-Salvin Collection which has been incorporated in the British Museum Collection.

All the figures are about $\frac{3}{4}$ of the natural size.

1. *Limenitis* (*Basilarchia*) *weidemeyeri*, Edwards. Glenwood, Colorado (6000 ft.), July 6, 1893. H. J. Elwes.

2. *Limenitis* (*Adelpha*) *bredowi*, Hübn., subspecies *californica*, Butl. Sissons, Oregon, May [1888]. F. D. Godman. The specimen bears only the month, but Dr Godman, F.R.S., kindly informs me that the year was 1888.

3. *Limenitis* (*Adelpha*) *bredowi*, subspecies *californica*. Yosemite, California, May 1888. F. D. Godman.

4. *Limenitis bredowi*, Hübn. Fort Grant, Arizona. Morrison.

5. *Limenitis bredowi*. Santa Rosa, Vera Paz, Guatemala. G. C. Champion.

6. *Limenitis* (*Najas*) *lorquini*, Boisd. Esquimalt, Vancouver's Island. Markham.

7. *Limenitis lorquini*. Sissons, Oregon, May [1888]. F. D. Godman. See description of Fig. 2.

8. *Limenitis lorquini*. Yosemite, California, May 1888. F. D. Godman.

9. *Limenitis bredowi*. Xucumanatlan, Guerrero, Mexico (7000 ft.), July. H. H. Smith.

10. *Limenitis weidemeyeri*. S.W. Colorado, Morrison.

Alfred Robinson, phot. Witherby & Co.

All figures are about ¾ of the natural size.

Resemblances between *Limenitis lorquini*, and *L. californica* at their geographical overlap, diminishing in *lorquini* to the N., and the *bredowi* form of *californica* to the S.

Explanation of Plate XXVI.

Mimicry of the Danaine butterfly, *Amauris niavius dominicanus*, by a *Papilio* and two *Nymphalinæ* in the Coast District of British East Africa. Another Nymphaline, *Euxanthe wakefieldi*, ♀, with a pattern nearer to *Amauris ochlea* and shown on the same plate with it (Plate XXVII, fig. 2), is during life an outlying member of this combination. The figures were prepared from the best of these 1906 specimens available, regardless of exact locality and date. Some of the time and space relationships of the combination are shown on p. 496. The figured specimens are in the Hope Department, Oxford University Museum.

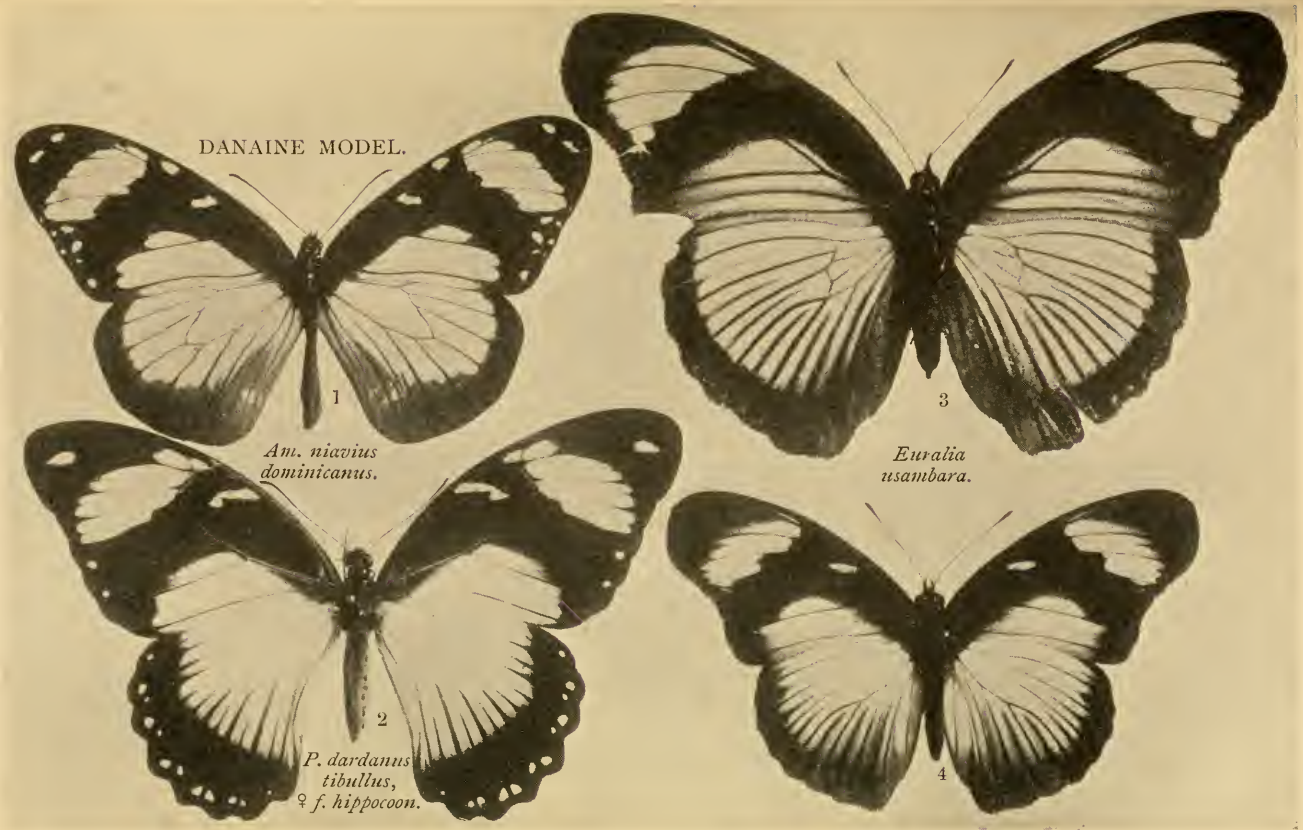
All the figures are $\frac{7}{8}$ of the natural size.

Fig. 1. *Amauris niavius*, sub-sp. *dominicanus*, ♀: Rabai, about 700 ft., 14 miles N.W. of Mombasa: September 15, 1906. The white markings are seen to be far more sharply defined than those of any of the mimics except the outlying *Euxanthe wakefieldi*, ♀ (Plate XXVII, fig. 2).

Fig. 2. *Papilio dardanus*, sub-sp. *tibullus*, ♀ f. *hippocoon:* captured November 3, 1906, at the same locality as the model shown in Fig. 1. The submarginal white spots of the hind-wing detract from the mimetic likeness, but are to some extent resembled by the female of *Euxanthe wakefieldi* (Plate XXVII, fig. 2).

Fig. 3. *Hypolimnas* (*Euralia*) *usambara*: captured at the same place and time as the model shown in Fig. 1. This rarest member of the combination lacks the important element of the pattern contributed by the spot in the fore-wing cell. The fulvous patch at the anal angle of the hind-wing barely visible in the figure, together with the much greater development of this colour on the under surface, is probably inconspicuous during flight (see p. 497).

Fig. 4. *Hypolimnas* (*Euralia*) *wahlbergi*: Mangea, about 500 ft., about 75 miles N. of Mombasa: July 19, 1906. Strong secondary resemblances are evident between this and the *Papilio* mimic shown in Fig. 2. Thus the appearance of the inter-nervular rays of the hind-wing, the outline of the chief white patch, and the character of its contour where the black ground colour deepens gradually, are very similar in both *Papilio* and Nymphaline (see Trans. Ent. Soc. Lond., 1902, p. 486, foot-note).



Alfred Robinson, phot.

All figures are ⅞ of the natural size.

Witherby & Co.

The Danaine, *Am. dominicanus*, mimicked by a female Papilio and by two Nymphalines. (Coast District of British East Africa, 1906.)

Explanation of Plate XXVII.

Mimicry of the pattern of the Danaine butterfly, *Amauris ochlea*, by *Nymphalinæ* (Coast District of British East Africa, 1906). The female of *Euxanthe wakefieldi* (Fig. 2), although possessing a form of the *ochlea* pattern, is during life an outlying member of the *dominicanus*-centred combination represented on Plate XXVI. Secondary resemblances between the other Nymphaline mimics are evident. The figures were prepared from the best of these 1906 specimens available, regardless of exact locality and date. Some of the time and space relationships of the combination are shown on p. 496. The figured specimens are in the Hope Department, Oxford University Museum.

All the figures are ⅔ of the natural size.

Fig. 1. *Amauris ochlea*, ♂: Rabai, about 700 ft., 14 miles N.W. of Mombasa: May 12, 1906. The outline of the white markings is very sharp. The mimetic resemblance to the model is not as perfect as that seen in the combination figured on Plate XXVI, but in the two species of *Hypolimnas* (*Euralia*) the likeness is striking.

Fig. 2. *Euxanthe wakefieldi*, ♀: captured, December 29, 1906, at the same locality as the model shown in Fig. 1. In spite of the pattern this species with its large white markings is an outlying member of the *Am. dominicanus*-centred combination shown on Plate XXVI.

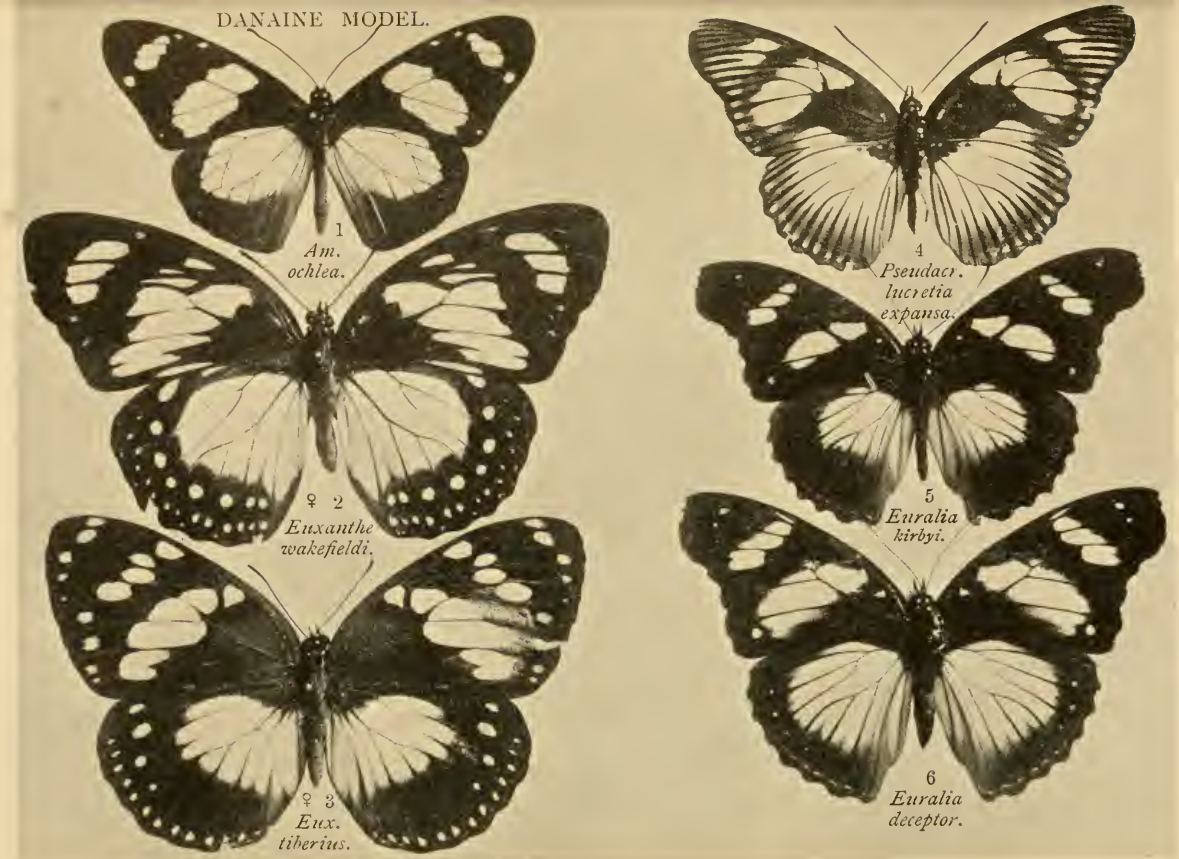
Fig. 3. *Euxanthe tiberius*, ♀: captured (in coitu), January 19, 1907, at the same locality as the model shown in Fig. 1. This species of *Euxanthe* with its smaller white markings is an outlying member of this combination. The curved direction of the chief white marking of the fore-wing is probably developed in secondary resemblance of the co-mimics shown in Figs. 4, 5 and 6. The fulvous base of the fore-wings, barely visible in the figure, detracts much from the mimetic likeness.

Fig. 4. *Pseudacræa lucretia*, sub-sp. *expansa*: captured at the same place and time as the specimen shown in Fig. 2. The resemblance to *ochlea* is very rough. This species is probably dominant among the mimics, and acts as a secondary model in respect to the form and direction of the chief marking in the fore-wing.

Explanation of Plate XXVII.

Fig. 5. *Hypolimnas* (*Euralia*) *kirbyi*: Jilore, Sabake River, about 200 ft., about 80 miles N. of Mombasa: July 14, 1906. The extraordinarily close resemblance between this and the next species is probably explained by arrested divergence as in many mimetic groups.

Fig. 6. *Hypolimnas* (*Euralia*) *deceptor*: Giryama country, 5–700 ft., about 45 miles N. of Rabai: July 20, 1906. The markings of this species, being larger than in *kirbyi*, produce a closer likeness to *ochlea*, compensated by the more prominent submarginal markings of the hind-wing. The curved marking of the fore-wing probably exhibits in both species the influence of the *Pseudacræa* (Fig. 4).



Alfred Robinson, phot. *All figures are ⅔ of the natural size.* Witherby & Co.

The pattern of the Danaine, *Am. ochlea*, mimicked by Nymphalines. Secondary resemblances between the mimics.

Explanation of Plate XXVIII.

Mimicry of a Danaine model, *Amauris albimaculata* (and probably *echeria* also) by the females, but not by the males, of three species of *Papilio*, in British East Africa (Kikuyu country: 1906–7). The figures were prepared from the best of these Kikuyu specimens available, regardless of precise locality. Some of the time and space relationships of the mimicking species are shown on pp. 509–511. The figured specimens are in the Hope Department, Oxford University Museum.

All the figures are about $\frac{2}{3}$ of the natural size.

Fig. 1. *Amauris albimaculata*, ♂: Kijabe Forest, about 7000 ft., Kikuyu country: August 3, 1906.

Fig. 2. *Papilio jacksoni*, ♀: captured at the same place and time as its model shown in Fig. 1.

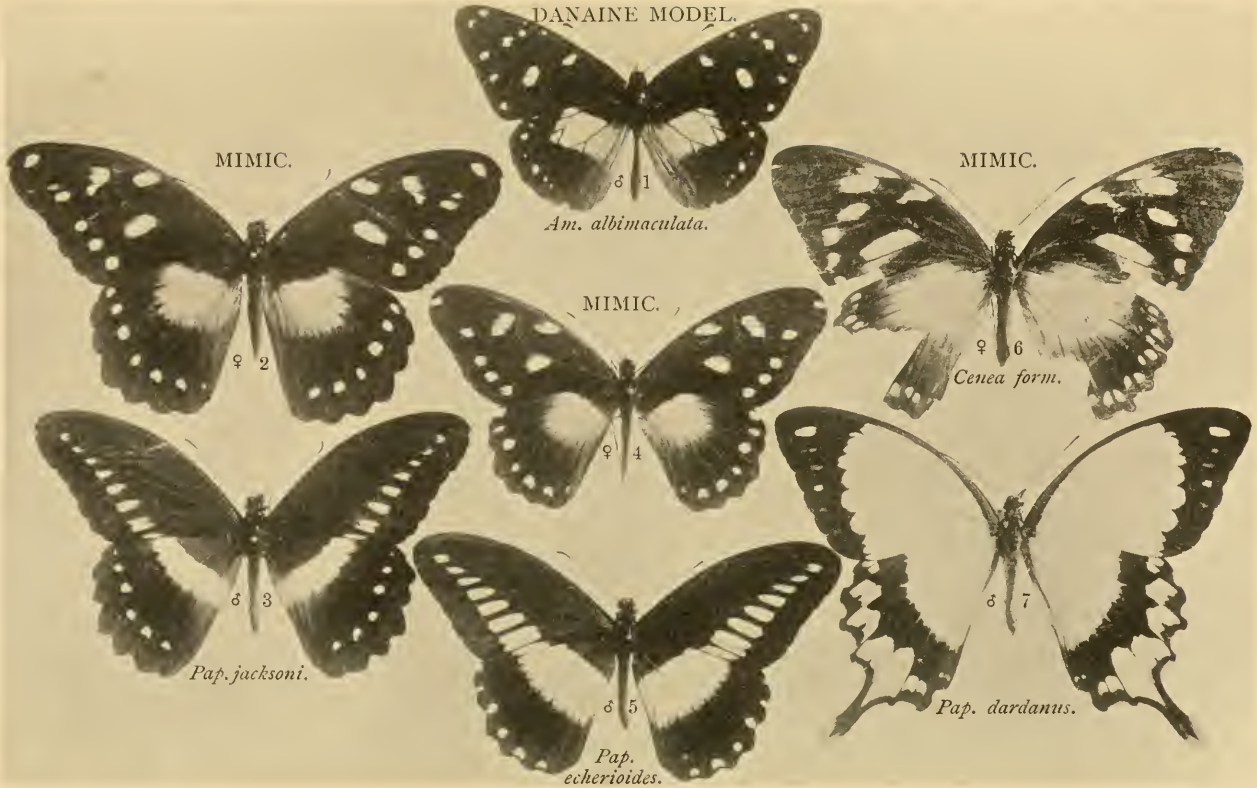
Fig. 3. *Papilio jacksoni*, ♂: Nairobi, about 5500 ft.: Feb. 4, 1907.

Fig. 4. *Papilio echerioides*, British East African form of, ♀: Weithaga, about 6000 ft., 15 miles W. of Fort Hall, Kikuyu country: March 30, 1907.

Fig. 5. *Papilio echerioides*, British East African form of, ♂: captured at the same place and time as the specimen shown in Fig. 3.

Fig. 6. *Papilio dardanus*, probably of the sub-species *tibullus*, ♀ form *cenea*: captured at the same place and time as the specimens shown in Figs. 3 and 5. The figured example is somewhat transitional towards the *hippocoon* female form, and a less perfect mimic than is usual in *cenea*.

Fig. 7. *Papilio dardanus*, probably of the sub-species *tibullus*, ♂: captured at the same place and time as the specimens shown in Figs. 3, 5 and 6. The specimen figured is an interesting variety, possessing a series of small pale submarginal spots in the black margin of the fore-wing. The males of *dardanus* usually possess the large sub-apical spot only.



Alfred Robinson, phot.

Witherby & Co.

All figures are about $\frac{2}{3}$ of the natural size.

Mimicry of the Danaine, *Am. albimaculata*, by the females of three Papilios in British East Africa (Kikuyu Country, 1906-7.)

Explanation of Plate XXIX.

Neptis woodwardi more closely mimetic of *Amauris albimaculata* in a locality to the E. of the Rift Valley, where this Danaine is dominant, than by the N.E. shores of the Victoria Nyanza, far to the W. of the Valley. Resemblances between British East African *Pierinæ* captured at the same place and time. The specimens are in the Hope Department, Oxford University Museum.

All the figures are very slightly under the natural size.

Fig. 1. *Neptis woodwardi*, ♂: Weithaga, about 6000 ft., 15 miles W. of Fort Hall, Kikuyu country: May 10, 1907. In the breadth of the ochreous hind-wing band and the size of the white fore-wing spots the pattern of the male, E. of the Rift Valley, is seen to be as closely mimetic of *Amauris albimaculata* (see Plate XXVIII, fig. 1) as is the pattern of the female from further W. (see Fig. 4).

Fig. 2. *Neptis woodwardi*, ♀: captured August 11, 1906, at the same locality as the specimen shown in Fig. 1. The pattern of the *Amauris* is more closely mimicked by the female *Neptis* than by the male from the same locality, shown in Fig. 1.

Fig. 3. *Neptis woodwardi*, ♂: Tiriki Hills, 5100 ft., 20 miles N. of Kisumu, N.E. shore of Victoria Nyanza: captured February 26, 1903, by C. A. Wiggins. The mimetic features are seen to be greatly reduced in the male from a locality far W. of the Rift Valley.

Fig. 4. *Neptis woodwardi*, ♀: captured by C. A. Wiggins, February 27, 1903, at the same locality as the specimen shown in Fig. 3. The mimetic appearance of the western female is seen to be about equal to that of the more eastern male (Fig. 1).

Fig. 5. *Mylothris agathina*, ♂, under surface: Rabai, about 700 ft., 14 miles N.W. of Mombasa: June 23, 1906. The orange flush at the base of the fore-wings extends on to the costal region of the base of the hind, although this feature is indistinctly shown in the figure.

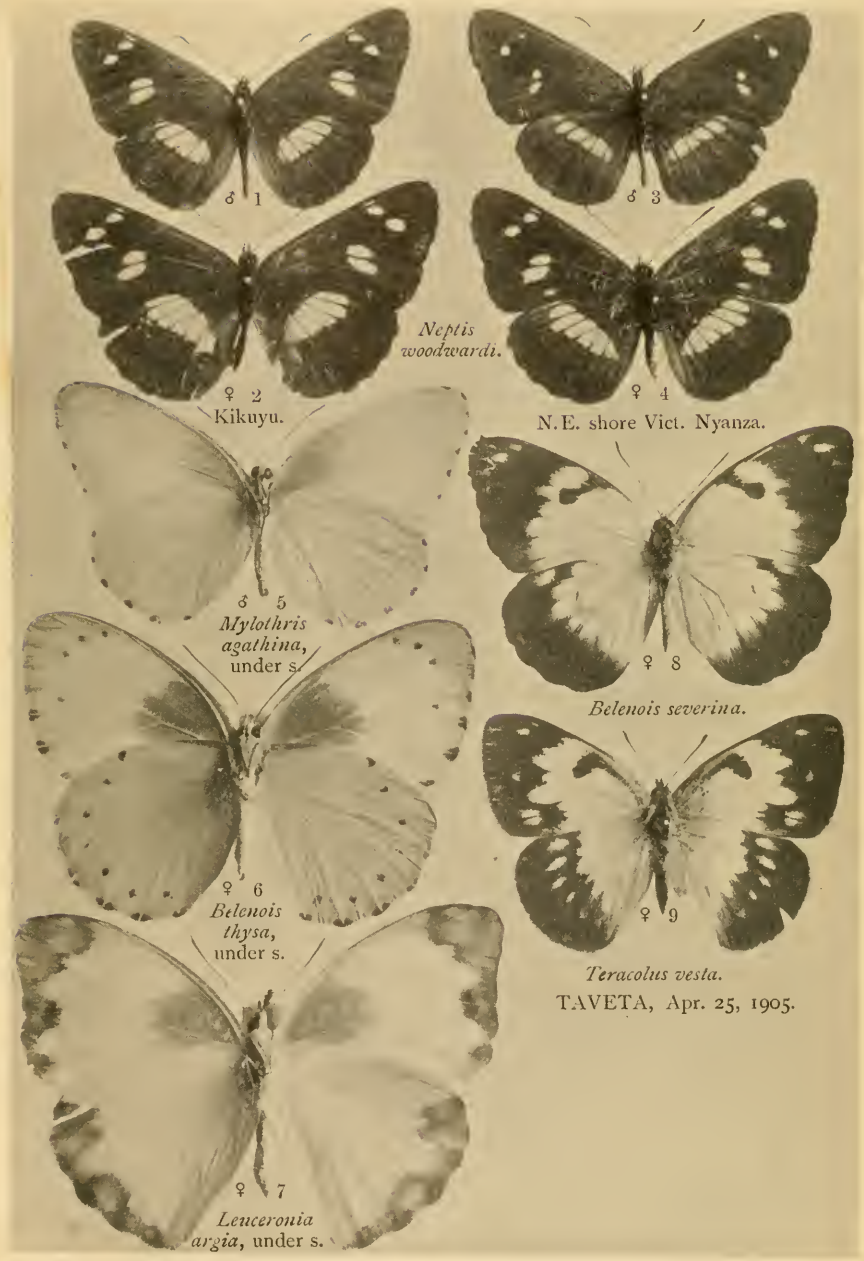
Fig. 6. *Belenois thysa*, ♀, under surface: captured at the same time and place as the model shown in Fig. 5. The orange flush at the base of the fore-wings is seen to be larger, of a deeper tint, and more sharply defined than in the model *Mylothris* (Fig. 5). It extends on to the costal border of the hind-wings as in the latter.

Explanation of Plate XXIX.

FIG. 7. *Leuceronia argia*, ♀, under surface: captured at the same time and place as the model shown in Fig. 5. The orange flush resembles that of the *Belenois* more closely than of the *Mylothris*: it does not extend on to the hind-wings. The mimetic resemblance to the *Mylothris* is very rough as compared with that of the *Belenois*.

FIG. 8. *Belenois severina*: ♀, Taveta, about 2500 ft.: April 25, 1905.

FIG. 9. *Teracola vesta*, ♀: captured at the same time and place as the specimen shown in Fig. 8. The close resemblance between these two very different Pierines is well shown in the figures.



RABAI, June 23, 1906.

Alfred Robinson, phot. Witherby & Co.

All figures are very slightly under natural size.

Mimicry in British East African Butterflies. Resemblances between *Pierinae*, captured at same place and time. Mimicry strengthened in *Neptis woodwardi* from a locality where the Danaine model is predominant.

Explanation of Plate XXX.

North Central American Ithomiine-centred Combination with banded "Melinæa" (Haase) pattern. Guatemala, Honduras and Nicaragua.

All the figures are half of the natural size and represent the upper side unless otherwise stated.

Ithomiinæ.

1. *Melinæa imitata*, Bates, ♂. Mirandilla (1700 ft). Pacific Slope of Guatemala. Hope Collection.

2. *Melinæa imitata*, Bates, ♀ (under side). Zapote, Guatemala. Hope Collection.

3. *Mechanitis doryssus*, Bates, ♂. V. de Sta. Maria, Pacific Slope, Guatemala. Hope Collection.

4. *Mechanitis doryssus*, Bates, ♀. Guatemala, Atlantic Slope, Vera Paz, Cubilguitz. March 10th–20th, 1880. Hope Collection.

5. *Ceratinia dionæa*, Hew., ♀. Mirandilla (1700 ft.). Hope Collection.

6. *Ceratinia dionæa*, Hew., ♂. Zapote, Guatemala. Hope Collection.

7. *Ceratinia fenestella*, Hew., ♂. Chontales, Nicaragua. Hope Collection.

8. *Ceratinia fenestella*, Hew., ♀. Nicaragua. 1871. Hope Collection.

Heliconinæ.

9. *Heliconius ismenius telchinia*, Dbld., Hew., ♂. Guatemala, Chiacaman, Vera Paz. Hope Collection.

10. *Heliconius ismenius telchinia*, Dbld., Hew., ♂ (under side). Guatemala, Chiacaman, Vera Paz. Hope Collection.

11. *Eueides cleobæa zorcaon*, Reak., ♂. Chontales, Nicaragua. Hope Collection.

12. *Eueides cleobæa zorcaon*, Reak., ♂. Nicaragua, 1871. Hope Collection.

Danainæ.

13. *Lycorea atergatis*, Dbld., Hew., ♂. Guatemala, Atlantic Slope, Vera Paz, Teleman. May 12th–18th, 1880. Hope Collection.

14. *Lycorea atergatis*, Dbld., Hew., ♂. Guatemala, Atlantic Slope, Vera Paz, Cubilguitz. March 10th–20th, 1880. Hope Collection.

Explanation of Plate XXX.

PIERINÆ.

15. *Perrhybris malenka*, Hew., ♂. Hope Collection.

16. *Perrhybris malenka*, Hew., ♀. Hope Collection.

17. *Dismorphia praxinœ*, Dbld., ♂. Guatemala (Central), S. Geronimo. August 10th, 1879–June 26th, 1880. Hope Collection.

18. *Dismorphia praxinœ*, Dbld., ♀. Chontales, Nicaragua. Hope Collection.

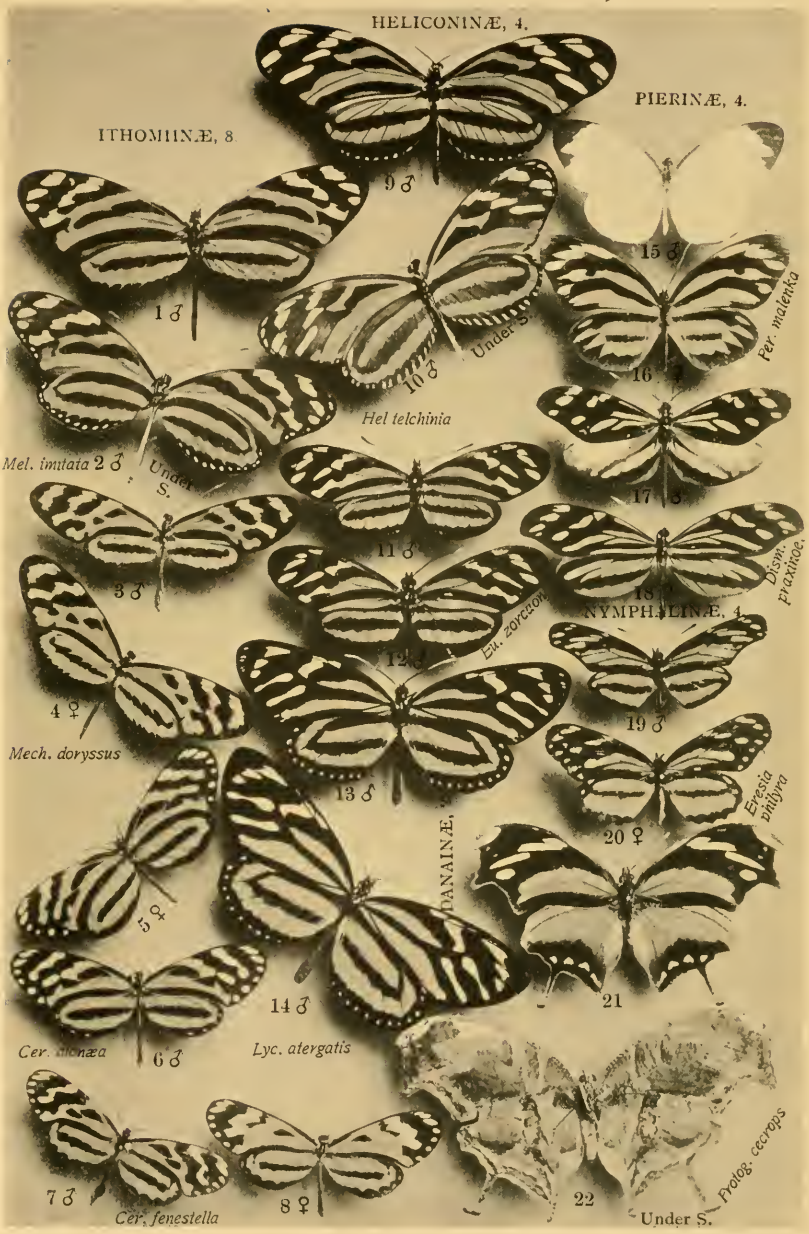
NYMPHALINÆ.

19. *Eresia philyra*, Hew., ♂. Guatemala, Chiacaman, Vera Paz. Hope Collection.

20. *Eresia philyra*, Hew., ♀. Guatemala, Chiacaman, Vera Paz. Hope Collection.

21. *Protogonius cecrops*, Dbld., Hew. Guatemala, Cahabon, Vera Paz. Godman-Salvin Collection.

22. *Protogonius cecrops*, Dbld., Hew. (under side). Pacific Slope, Guatemala. Godman-Salvin Collection.



Alfred Robinson, phot. *Andre & Sleigh, Ltd*

All figures are ½ of the natural size.

North Central American Ithomiine-centred Combination, with banded "Melinæa" (Haase) pattern.

Guatemala to Nicaragua and Honduras.

Explanation of Plate XXXI.

East Brazilian Ithomiine-centred Combination, characterised by yellow hind-wing band and white apical fore-wing marking.

All the figures are about two-thirds of the natural size, and represent the upper side, unless otherwise stated.

Ithomiinæ.

1. *Mechanitis lysimnia*, Fabr., ♂. Captured March 10th, 1826, by W. J. Burchell, at Rio de Janeiro. Hope Collection.

2. *Mechanitis lysimnia*, Fabr., ♀ (under side). Sao Paulo, S. Brazil. "Winter." Hope Collection.

3. *Ceratinia daeta*, Boisd., ♀. Miers Collection. From the neighbourhood of Rio. Hope Collection.

4. *Ceratinia daeta*, Boisd., ♀ (under side). Brazil. Hope Collection.

5. *Napeogenes euryanassa*, Feld., ♀. Rio. Hope Collection.

6. *Napeogenes euryanassa*, Feld., ♂ (under side). Rio. Collected by S. Youds. Hope Collection.

Heliconinæ.

7. *Heliconius narcæa narcæa*, Godt., ♀. Petropolis, Brazil. Hope Collection.

8. *Heliconius narcæa narcæa*, Godt., ♂ (under side). Petropolis, Brazil. Hope Collection.

9. *Heliconius narcæa polychrous*, Feld., ♂. Captured August 29th, 1827 (a.m.), by W. J. Burchell, at Cervo, N. of Rio Pardo, Brazil. Hope Collection.

Nymphalinæ.

10. *Protogonius drurii*, Butl., ♂. Hope Collection.

11. *Protogonius drurii*, Butl., ♀ (under side). Hope Collection.

Alfred Robinson, phot. *Andre & Sleigh, Ltd.*

All figures are about ⅔ of the natural size.

East Brazilian Ithomiine-centred Combination, characterised by yellow hind wing band and white apical fore wing marking.

Explanation of Plate XXXII.

Upper Amazons (Ega) Ithomiine-centred Combination, characterised by a mahogany or chestnut suffusion, and the mottled appearance of the fore-wing.

All the figures are about two-thirds of the natural size, and represent the upper side, unless otherwise stated.

Danainæ.

1. *Lycorea cinnamomea*, Weymer. Upper Amazons, Manaos. Hope Collection.

Ithomiinæ.

2. *Melinæa pardalis*, Bates, sub-sp. nov. *madeira*, ♀. Amazons. Hope Collection. The figure represents the type of the female. This sub-species occurs on the Rio Madeira to the S.E. of Ega.

3. *Melinæa pardalis*, Bates, ♂ (under side). Hope Collection.

4. *Mechanitis egaensis*, Bates, ♂. Amazons, Bates, 1860. Hope Collection.

5. *Mechanitis egaensis*, Bates, ♀. Hope Collection.

Pierinæ.

6. *Dismorphia egaëna*, Bates, ♂. Ega, H. W. Bates. Godman-Salvin Collection.

7. *Dismorphia egaëna*, Bates, ♀. Lower Napo, H. W. Bates. Godman-Salvin Collection.

Heliconinæ.

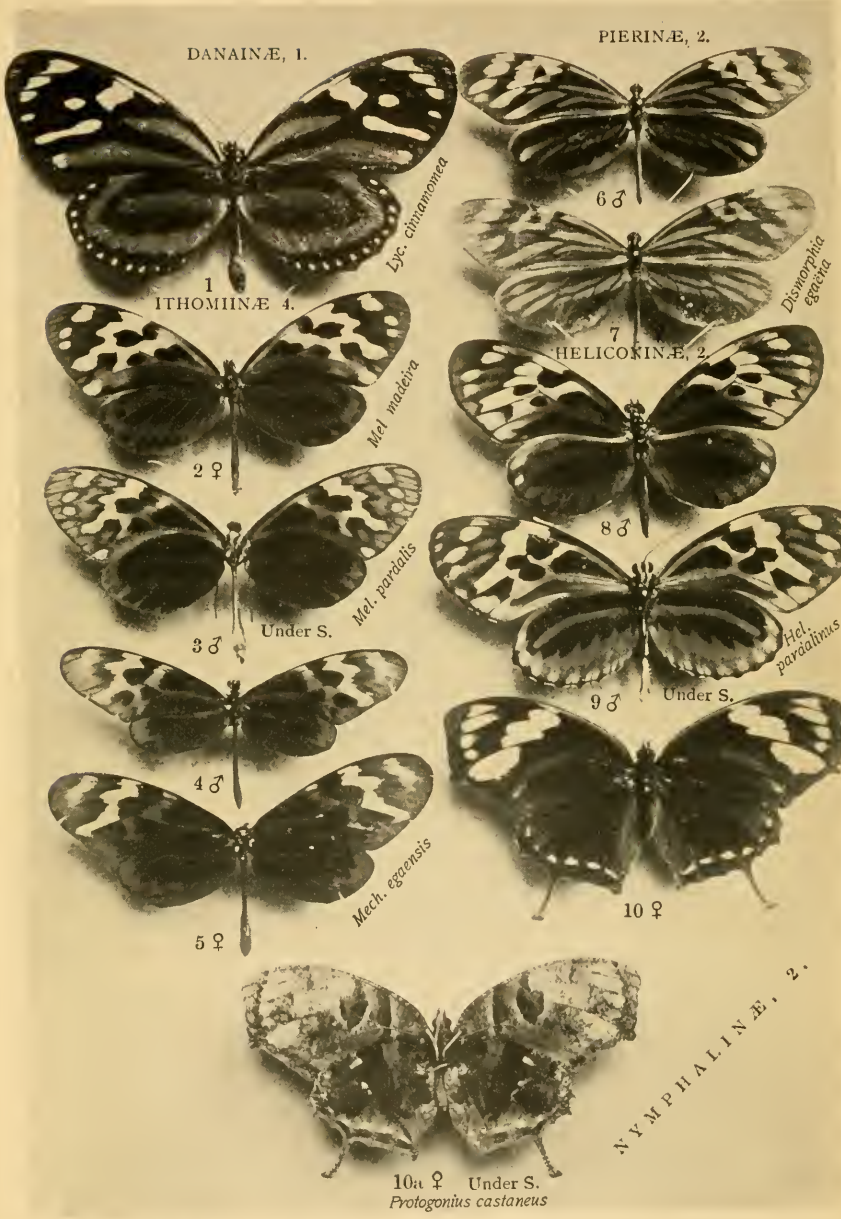
8. *Heliconius pardalinus pardalinus*, Bates, ♂. Hope Collection.

9. *Heliconius pardalinus pardalinus*, Bates, ♂ (under side) Manaos, Amazons. 1876. Godman-Salvin Collection.

Nymphalinæ.

10. *Protogonius castaneus*, Butl., ♀. Ega, H. W. Bates. Godman-Salvin Collection.

10*a*. *Protogonius castaneus*, Butl., ♀. Under side of Fig. 10.



Alfred Robinson, phot.

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All figures are about $\frac{3}{5}$ of the natural size.

Upper Amazons (Ega) Ithomiine-centred Combination, characterised by a mahogany or chestnut suffusion and by the mottled appearance of the fore wing.

Explanation of Plate XXXIII.

Ecuador, Peru and Bolivia Combination, characterised by orange-tawny markings on a black ground.

All the figures are half of the natural size, and represent the upper side, unless otherwise stated.

Ithomiinæ.

1. *Melinæa mothone*, Hew., ♂. Peru. Hope Collection.
2. *Melinæa mothone*, Hew., ♀ (under side). N. Peru. Hope Collection.
3. *Hyposcada fallax*, Staud., ♀. Peru. Hope Collection.
4. *Mechanitis deceptus*, Butl., ♂. Ecuador. From collection of W. W. Saunders, 1830–73. Hope Collection.
5. *Mechanitis deceptus*, Butl., ♀. Ecuador, 1870. Higgins. Hope Collection.

Heliconinæ.

6. *Heliconius aristiona aristiona*, Hew., ♂. Chairo, Bolivia. C. Buckley (Druce Collection). Godman-Salvin Collection.
7. *Heliconius aristiona aristiona*, Hew., ♂ (under side). Rio Juntas, Bolivia, 3000 ft. (Garlepp). Godman-Salvin Collection.
8. *Eueides acacetes*, Hew. Peru (Druce Collection). Godman-Salvin Collection.
9. *Eueides acacetes*, Hew. (under side). Bolivia. C. Buckley, Godman-Salvin Collection.

Acræinæ.

10. *Actinote acipha*, Hew., ♂. Rio Verdi, Ecuador. C. Buckley. Godman-Salvin Collection.
11. *Actinote acipha*, Hew., ♀. Esmeraldas, Ecuador. Lehmann. Godman-Salvin Collection.

Nymphalinæ.

12. *Eresia ithomiola*, Salv., ♀. Aguana, Ecuador. Simson. Godman-Salvin Collection.
13. *Eresia ithomiola*, Salv., ♀. Cururai, Ecuador. C. Buckley (Druce Collection). Godman-Salvin Collection.
14. *Protogonius semifulvus*, Butl., ♂. Hope Collection.
15. *Protogonius semifulvus*, Butl., ♂ (under side). Hope Collection.

Papilioninæ.

16. *Papilio bachus bachus*, Feld., ♂. S. Ecuador. Godman-Salvin Collection.

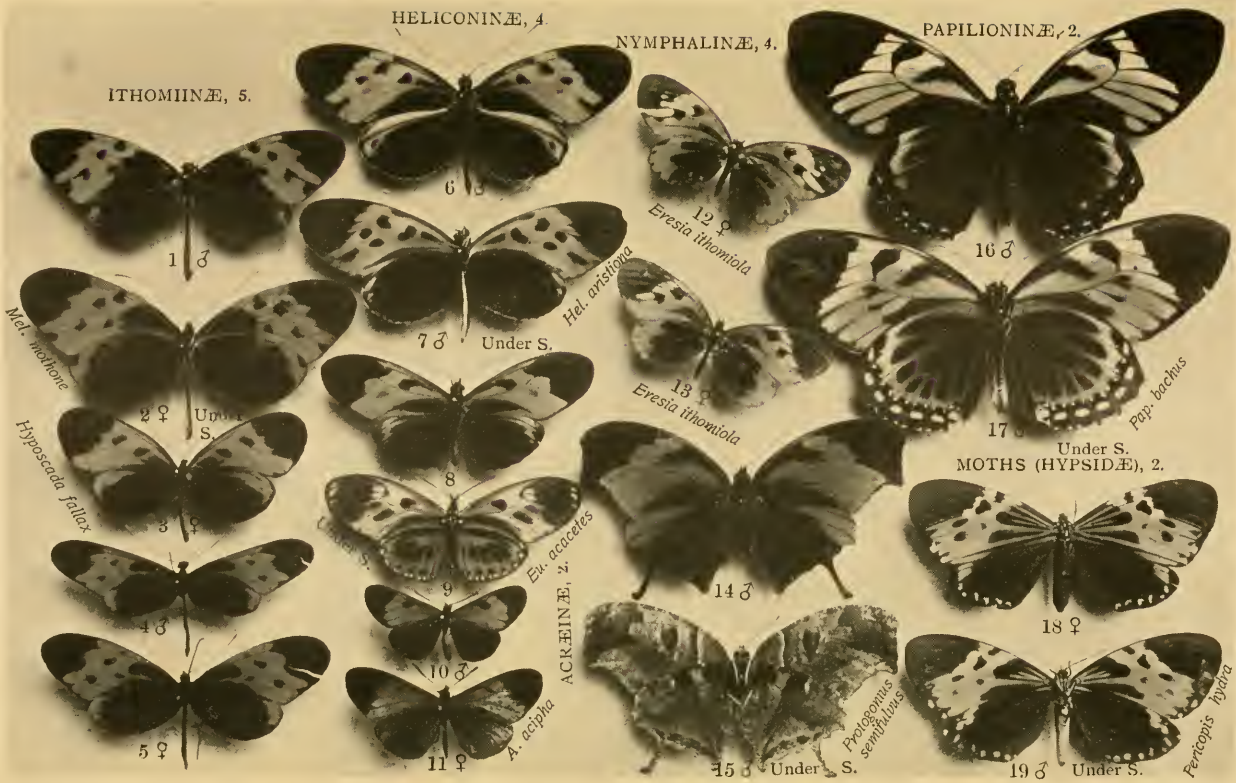
Explanation of Plate XXXIII.

17. *Papilio bachus bachus*, Feld., ♂ (under side). Peru (Kaden Collection). Godman-Salvin Collection.

HETEROCERA (HYPSIDÆ).

18. *Pericopis hydra*, Butl., ♀. Hope Collection.

19. *Pericopis hydra*, Butl., ♂ (under side). Ecuador. The figure represents the type of the species. Hope Collection.



Alfred Robinson, phot.

Andre & Sleigh, Ltd.

All figures are ½ of the natural size.

Ecuador, Peru and Bolivia Combination, characterised by orange-tawny markings on a black ground.

Explanation of Plate XXXIV.

Müllerian (Synaposematic) Combinations among Old World *Danainæ*,—chiefly *Euplœini*. The patterns are characteristically Euplœine.

All the figures are about three-fifths of the natural size, and represent the upper side.

Euplœini.

1. *Narmada coreoides*, Moore, ♂. Utakamand, Nilgiris (7500 ft.) April 14th, 1896. A. G. Cardew. Hope Collection.

2. *Crastia core*, Cram., ♂. Cannanore, Malabar, India. September 3rd, 1896. A. G. Cardew. Hope Collection.

3. *Pademma kollari*, Feld., ♂. Cannanore, Malabar, India. September 3rd, 1896. A. G. Cardew. Hope Collection.

4. *Nipara eleutho*, Quoy. = *eschscholtzii*, Feld., ♂. Fiji, Viti Levu, S. of mouth of Rewa River, Coral Island, near Nukulau. October 15th, 1897. Gustav Gilson. Hope Collection.

5. *Euplœa asyllus*, Godm. and Salv., ♀. Fauro Island, Solomon Islands. End of August and early September, 1886. C. M. Woodford. Hope Collection.

6. *Narmada coreoides*, Moore, ♀. Bombay. Hope Collection.

7. *Crastia core*, Cram., ♀. Cannanore, Malabar, India. September 3rd, 1896. A. G. Cardew. Hope Collection.

8. *Pademma kollari*, Feld., ♀. Cannanore, Malabar, India. September 3rd, 1896. A. G. Cardew. Hope Collection.

9. *Deragena proserpina*, Butl., ♂. Fiji, Viti Levu, S. of mouth of Rewa River, Coral Island, near Nukulau. October 15th, 1897. Gustav Gilson. Hope Collection.

Danaini.

10. *Salatura decipiens*, Butl., ♀. Fauro Island, Solomon Islands. End of August and early September, 1886. C. M. Woodford. Hope Collection.

Alfred Robinson, phot. *Andre & Sleigh, Ltd.*

All figures are about $\frac{3}{5}$ of the natural size.

Müllerian (Synaposematic) Combinations among Old World Danainæ,—chiefly Euplœini. The patterns are characteristically Euplœine.

Explanation of Plate A.

Fig. 1. *Bothria chennellii.*

„ 2. *Celastrina argiolus*, var. *bothrioides*, sent to me as *chennellii.*

„ 3. *Celastrina argiolus*, var. *sikkima* (Moore). From a specimen labelled *jynteana* by Moore.

„ 4. *Notarthrinus binghami.* From some different quality in the colours, the photographs show a more marked difference between this and Fig. 1 than appears in the specimens. Fig. 1 is from a well-marked dark specimen.

„ 5. *Celastrina argiolus*, var. *sikkima* (Moore).

„ 6. „ *limbatus*, var. *jynteana* (Moore).

„ 7. *Everes dipora. E. argiades*, var. *diporides*, is indistinguishable on the upper side.

„ 8. *Celastrina argiolus*, var. *hugelii.* This may be taken as the more normal form, of which Figs. 2, 3, 5, 10 and 12 are local races.

„ 9. *Celastrina limbatus*, normal form of which *jynteana* (Fig. 6) is a variety.

„ 10. *Celastrina argiolus*, var. *albocæruleoides* (Tutt's "Brit. Lep.," vol. ix, p. 404).

„ 11. *Celastrina puspa*, from the same locality as Fig. 12.

„ 12. „ *argiolus*, var. *puspargiolus.* Blue and whites being for the camera almost identical, the white patches on Figs. 10, 11 and 12 do not appear in the photographs.

The specimens 11 and 12 were collected in Assam (or Simla) by Col. E. R. Johnson, and given to me (with others) in papers by Col. Bingham.

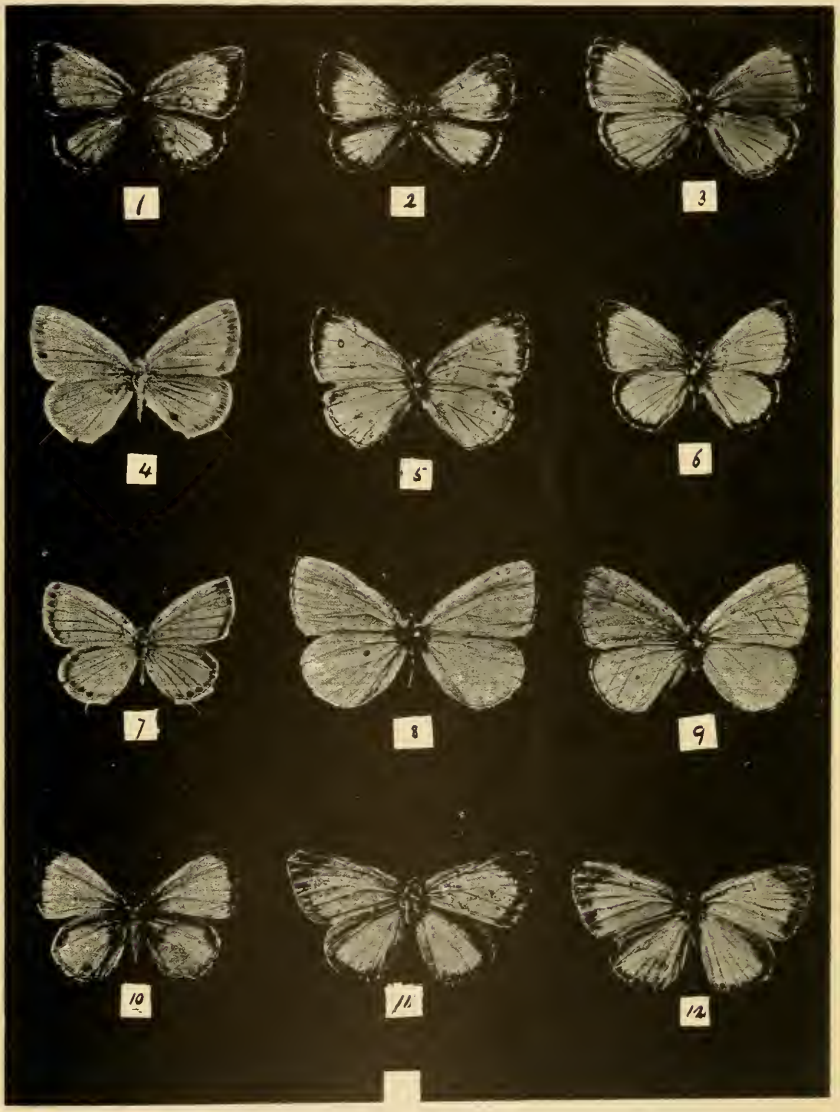


Photo. A. E. Tonge.

IMAGINES OF EVERID AND CELASTRINID SPECIES.

Explanation of Plate B.

Fig. 1. Male appendages of *Celestrina limbatus* = *C. placida* = *C. jynteana*.

„ 2. Male appendages of *Zizera dryina*, n. sp.

Photo. F. N. Clark.

MALE APPENDAGES OF (1) CELASTRINA LIMBATUS (JYNTEANA); (2) ZIZERA DRYINA, N. SP.

Explanation of Plate C.

Fig. 1. Male appendages of *Everes dipora*.
„ 2. „ „ „ „ *argiades*, var. *diporides*.
„ 3. „ „ „ *Cupido minimus*.

This plate may be taken in connection with Plates XIX and XX and the paper they illustrate; indeed Fig. 3 is added with that object to show how close *C. minimus* is to *E. argiades* and how comparatively different *B. parrhasius* is, and to show, *minimus* being so close, that the small (but constant) differences between *E. argiades* and *E. coretas* are of more weight than one is at first inclined to attach to them.

The appendages of *C. argiolus* will be found figured in Tutt's "Brit. Lep.," vol. ix, Pl. xxviii; of *Bothria chennellii* and *Notarthrinus binghami*, in Proc. Zool. Soc., 1908, Pl. xxxviii.

Photo. F. N. Clark.

MALE APPENDAGES OF (1) EVERES DIPORA; (2) EVERES ARGIADES VAR. DIPORIDES; (3) CUPIDO MINIMUS.

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